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COMPUTER CENTER LIBRARIES.(U)
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1 OF 2
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# DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Md. 20084



## COMPUTER CENTER LIBRARIES

by

David V. Sommer

&

Sharon E. Good

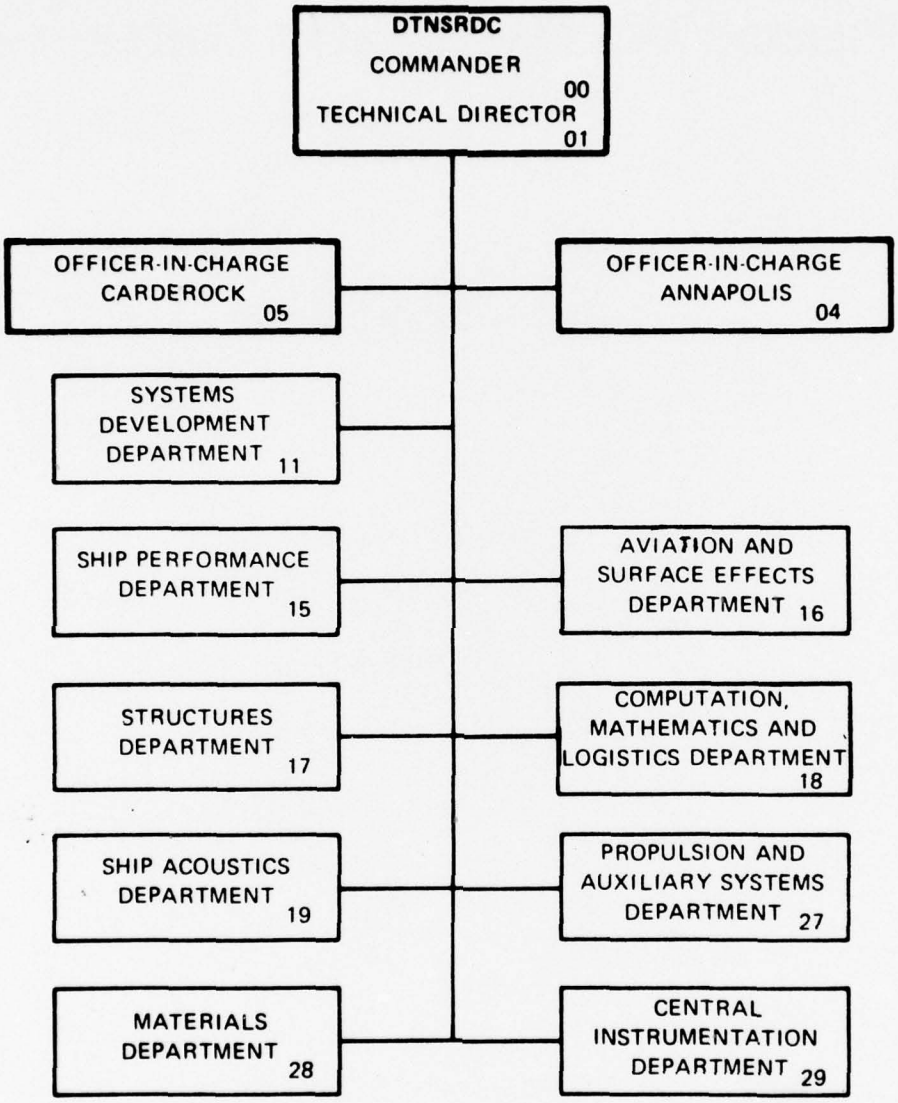


Computation, Mathematics
and Logistics Department

August 1977

CMLD-77-12

## MAJOR DTNSRDC ORGANIZATIONAL COMPONENTS



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The Computer Center Libraries (CCLIB) Manual is a cross reference volume for many subprograms, programs, utilities and procedures available at the DTNSRDC Computer Center. CCLIB lists the routines by functional category and alphabetically, by libraries, with descriptive title.

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AB

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NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER
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# COMPUTER CENTER LIBRARIES

BY
DAVID V SOMMER
SHARON E GOOD
USER SERVICES BRANCH

CODE 1892



COMPUTATION, MATHEMATICS AND LOGISTICS DEPARTMENT
DEPARTMENTAL REPORT

AUG 1977 CMLD-77-12

THROUGH REVISION 0 (AUG 1977)

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## ***** INTRODUCTION *****

THE COMPUTER CENTER MAKES AVAILABLE, IN ADDITION TO THE NOS/BE OPERATING SYSTEM, A WIDE VARIETY OF BOTH SCIENTIFIC AND UTILITY PROGRAMS, SUBPROGRAMS AND CATALOGUED PROCEDURES. MOST OF THE ROUTINES ARE MAINTAINED IN LIBRARIES ON PERMANENT FILES AND MAY BE INVOKED BY THE APPROPRIATE (LOADER) CONTROL CARDS. A FEW PROGRAMS ARE AVAILABLE AS INDEPENDENT PERMANENT FILES.

THE CCLIB-SERIES OF MANUALS CONTAINS THE FOLLOWING, WHICH DESCRIBE THE CONTENTS OF THE VARIOUS LIBRARIES MAINTAINED BY THE COMPUTER CENTER:

| | | |
|---|---|---|
| CCLIB | - COMPUTER CENTER LIBRARIES | CMLD-77-12 |
| CCLIB/N | - COMPUTER CENTER LIBRARIES/NSROC (SUBPROGRAMS) | CMLD-77-15 |
| CCLIB/P | - COMPUTER CENTER LIBRARIES/PROFIL (PROCEDURES) | CMLD-77-16 |
| CCLIB/U | - COMPUTER CENTER LIBRARIES/UTILITY (PROGRAMS) | CMLD-77-17 |
| CCLIB/M | - COMPUTER CENTER LIBRARIES/MNSROC (PROGRAMS) | |

THIS MANUAL, CCLIB, IS A CROSS-REFERENCE MANUAL WHICH DESCRIBES ALL THE LIBRARIES AND INDICATES A SOURCE FOR MORE COMPLETE DOCUMENTATION ON HOW TO USE THE ROUTINES IN THE LIBRARIES. REFERENCES MAY BE TO OTHER PUBLISHED BOOKS, MACHINE-READABLE DOCUMENTATION OR MASTER COPIES ON FILE IN USER SERVICES. THE OTHER MANUALS IN THIS SERIES CONTAIN MACHINE-READABLE DOCUMENTS.

ALL REFERENCE MATERIAL IS AVAILABLE FOR PERUSAL IN USER SERVICES (CARDEROCK: BLDG 17, ROOM 100, (202) 227-1907; ANNAPOLIS: BLDG 100, ROOM 2-J, (301) 267-3343). COPIES OF THE CCLIB-SERIES MAY BE OBTAINED FROM USER SERVICES.

## *** HOW TO USE THIS MANUAL ***

THE ROUTINES ARE CLASSIFIED IN ONE OR MORE FUNCTIONAL CATEGORIES (SEE PAGE 1-3 FOR A LIST OF CATEGORIES). THEY ARE LISTED, BEGINNING ON PAGE 1-6, UNDER THE VARIOUS CATEGORIES. EACH ENTRY IN THIS LIST INDICATES THE TYPE OF ROUTINE, THE LIBRARY (IF ANY) WHERE IT MAY BE FOUND, AND THE LOCATION OF THE DETAILED DOCUMENT WHICH DESCRIBES ITS USE.

THE ROUTINES LISTED IN THIS MANUAL ARE DIVIDED BY TYPE (PROGRAM, SUBPROGRAM OR CATALOGUED PROCEDURE), IN CHAPTERS 2, 3 AND 4, RESPECTIVELY. THESE CHAPTERS DESCRIBE THE VARIOUS LIBRARIES AVAILABLE AND LIST THE ROUTINES IN EACH LIBRARY (WITH A DESCRIPTIVE TITLE) ALPHABETICALLY.

## *** HOW TO PRINT INDIVIDUAL DOCUMENTS ***

INDIVIDUAL DOCUMENTS FOR MANY ROUTINES MAY BE PRINTED BY ONE OF THE FOLLOWING:

1) FOR LIBRARIES NSRDC, PROFIL, UTILITY, MNSRDC, OTHER*:

```
JOBNAME,....
CHARGE,....
BEGIN,UTILITY,,PROGDOC,<LIBRARY>,,<ROUTINE>,OUTPUT.
```

2) FOR LIBRARIES ARLNALG, EISPACK, FUNPACK, IMSL:

```
JOBNAME,MT1,....
CHARGE,....
BEGIN,DOCTAPE,,<LIBRARY>,<ROUTINE>,OUTPUT.
```

WHERE <LIBRARY> IS THE LIBRARY CONTAINING THE ROUTINE
<ROUTINE> IS THE NAME OF THE ROUTINE WHOSE DOCUMENTATION IS DESIRED.

* - PSEUDO-LIBRARY 'OTHER' IS A COLLECTION OF MISCELLANEOUS DOCUMENTS NOT PRINTED IN ANY MANUAL (SEE PAGE 2-11).

## *** FUNCTIONAL CATEGORIES ***

THE FOLLOWING FUNCTIONAL CATEGORIES ARE USED AT DTNSRDC. THOSE PRECEDED BY AN ASTERISK (*) ARE LOCAL DTNSRDC CATEGORIES. ALL OTHERS ARE FROM THE VIM (THE CDC USERS GROUP) LIST.

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H9 COMBINED

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I2 OCTAL
I3 DECIMAL
I4 BCD (HOLLERITH)
I9 COMPOSITE

J0 OUTPUT
J1 BINARY
J2 OCTAL
J3 DECIMAL
J4 BCD (HOLLERITH)
J5 PLOTTING
J7 ANALOG
J9 COMPOSITE

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Y2 NEWPL TAPE OF INSTALLATION MODIFICATIONS

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## *** LIST OF ROUTINES BY FUNCTIONAL CATEGORY ***

THE FOLLOWING IS A LIST OF ROUTINES DISCUSSED IN THE CCLIB SERIES OF MANUALS. EACH ROUTINE APPEARS UNDER THE CATEGORY(IES) TO WHICH IT HAS BEEN ASSIGNED.

EACH ENTRY HAS THE FOLLOWING FORM:

NAME/TYPE/LIB/DOC/

WHERE NAME IS THE ROUTINE NAME
(MAY BE ABBREVIATED TO FIT INTO 7 CHARACTERS (SPSS))

TYPE IS THE KIND OF ROUTINE
- D - MAIN PROGRAM ACTIVATED BY A DATA CARD (SPSS, COMRADE)
- M - MAIN PROGRAM
- P - PROCEDURE
- S - SUBPROGRAM

LIB IS THE LIBRARY CONTAINING THE ROUTINE
(THE NUMBER IN PARENTHESES FOLLOWING EACH LIBRARY NAME BELOW IS THE PAGE IN THIS MANUAL WHERE THE LIBRARY IS DISCUSSED)
- A - ARLNALG (3-2)
- B - BIMED (2-1)
- C - BIMEDP (2-3)
- D - EDSTAT (3-4)
- E - EISPACK (3-6)
- F - FUNPACK (3-10)
- I - IMSL (3-12)
- M - MSL (3-34)
- N - NSRDC (3-54)
- P - PROFIL (4-1)
- R - MNSRDC (2-4)
- S - SPSS (2-5)
- U - UTILITY (2-7)
- BLANK - NOT IN A LIBRARY

DOC INDICATES THE MANUAL WHERE THE ROUTINE IS DOCUMENTED
- M - CCLIB/MNSRDC (PROGRAMS)
- N - CCLIB/NSRDC (SUBPROGRAMS)
- P - CCLIB/PROFIL (PROCEDURES)
- R - CCRM (COMPUTER CENTER REFERENCE MANUAL)
  (MAY CONTAIN ENOUGH INFORMATION TO USE THE ROUTINE OR A FURTHER REFERENCE.)
- U - CCLIB/UTILITY (PROGRAMS)
- * - USER SERVICES HAS THE DOCUMENT
- BLANK - FOR DOCUMENTATION LOCATION, SEE THE DISCUSSION OF THAT LIBRARY IN THIS MANUAL

A0 ARITHMETIC ROUTINES

| | | | | | |
|---|---|---|---|---|---|
| FAFRAC | /S/M/ / | HCF | /S/M/ / | VDCPS | /S/I/ / |
| FFRAC | /S/M/ / | ICOMN | /S/N/*/ | XOR | /S/N/*/ |
| FMFRAC | /S/M/ / | LCM | /S/M/ / | | |

A1 REAL NUMBERS

| | | | |
|---|---|---|---|
| AMCON | /S/M/ / | NFILL | /S/N/N/ |
| ISUMIT | /S/N/N/ | SUMIT | /S/N/N/ |

A2 COMPLEX NUMBERS

| | | | | | |
|---|---|---|---|---|---|
| CADR | /S/M/ / | COMBES | /S/M/ / | MULLP | /S/M/ / |
| CBAREX | /S/M/ / | CPDIV | /S/M/ / | POLYMUL | /M/R/M/ |
| CCOMPE | /S/M/ / | CPOLRT | /S/M/ / | PSI | /S/N/*/ |
| CCONGR | /S/M/ / | CPTRAN | /S/M/ / | SUBDIA | /S/M/ / |
| CDERIV | /S/M/ / | CQDIV | /S/M/ / | VALVEC | /S/M/ / |
| CFBSUM | /S/M/ / | CREV | /S/M/ / | VECORD | /S/M/ / |
| CGITRF | /S/M/ / | CSBR | /S/M/ / | ZAFUJ | /S/M/ / |
| CGLESM | /S/M/ / | CSHRNK | /S/M/ / | ZAFUM | /S/M/ / |
| CINPRD | /S/M/ / | ELRH1C | /S/I/ / | ZAFUR | /S/M/ / |
| CINT | /S/M/ / | ELRH2C | /S/I/ / | ZCOUNT | /S/M/ / |
| CITERF | /S/M/ / | ELZHC | /S/I/ / | ZCPOLY | /S/I/ / |
| CLDIV | /S/M/ / | ELZVC | /S/I/ / | ZQADC | /S/I/ / |
| CMPINV | /S/N/N/ | HARM | /S/M/ / | ZQADR | /S/I/ / |
| CMPYR | /S/M/ / | HELP | /S/M/ / | | |
| CNSLVL | /S/M/ / | HELP | /S/N/N/ | | |

B1 TRIGONOMETRIC

| | | | |
|---|---|---|---|
| COTAN | /S/N/*/ | SICI | /S/M/ / |

B3 EXPONENTIAL AND LOGARITHMIC

| | |
|---|---|
| CBAREX | /S/M/ / |

B4 ROOTS AND POWERS

| | | | | | |
|---|---|---|---|---|---|
| DPROOT | /S/N/N/ | PROOT | /S/N/N/ | SUMPS | /S/M/ / |

C1 EVALUATION OF POLYNOMIALS

| | | | | | |
|---|---|---|---|---|---|
| ADR | /S/M/ / | CQDIV | /S/M/ / | PARFAC | /S/M/ / |
| APOWR | /S/N/*/ | CREV | /S/M/ / | PDIV | /S/M/ / |
| BPOWR | /S/N/*/ | CSBR | /S/M/ / | POLDIV | /S/N/*/ |
| CADR | /S/M/ / | CSHRNK | /S/M/ / | POWR1 | /S/N/*/ |
| CCOMPE | /S/M/ / | DERIV | /S/M/ / | POWR2 | /S/N/*/ |
| CDERIV | /S/M/ / | EVREAL | /S/M/ / | PROD2 | /S/N/*/ |
| CLDIV | /S/M/ / | FMULT1 | /S/M/ / | PTRAN | /S/M/ / |
| CMPYR | /S/M/ / | HIFAC | /S/N/*/ | QDIV | /S/M/ / |
| CNSLVL | /S/M/ / | IBCEVU | /S/I/ / | REV | /S/M/ / |
| COMPEV | /S/M/ / | ICSEVU | /S/I/ / | SBR | /S/M/ / |
| COSEVL | /S/M/ / | LDIV | /S/M/ / | SHRINK | /S/M/ / |
| CPDIV | /S/M/ / | MPYR | /S/M/ / | SINEVL | /S/M/ / |
| CPTRAN | /S/M/ / | NSLVL | /S/M/ / | | |

C2 ROOTS OF POLYOMIALS

| | | | | | |
|---|---|---|---|---|---|
| CINT | /S/M/ / | MULLP | /S/M/ / | ZCPOLY | /S/I/ / |
| CPOLRT | /S/M/ / | NROOTS | /S/N/*/ | ZPOLR | /S/I/ / |
| DPROOT | /S/N/N/ | POLYMUL | /M/R/M/ | ZQADC | /S/I/ / |
| HELP | /S/M/ / | PROOT | /S/M/ / | ZQADR | /S/I/ / |
| HELP | /S/N/N/ | PROOT | /S/N/N/ | ZRPOLY | /S/I/ / |
| INT | /S/M/ / | QUART | /S/N/*/ | | |

C3 EVALUATION OF SPECIAL FUNCTIONS (NON-STATISTICAL)

| | | | | | |
|---|---|---|---|---|---|
| AI | /S/N/*/ | DAW | /S/F/ / | MERFC | /S/I/ / |
| BEJY0 | /S/N/*/ | EI | /S/F/ / | MERFCI | /S/I/ / |
| BEJY1 | /S/N/*/ | ELF | /S/M/ / | MERFI | /S/I/ / |
| BESEI0 | /S/F/ / | ELIEM | /S/F/ / | MGAMMA | /S/I/ / |
| BESEI1 | /S/F/ / | ELIE1 | /S/F/ / | MLGAMA | /S/I/ / |
| BESEK0 | /S/F/ / | ELIKM | /S/F/ / | MMBSI0 | /S/I/ / |
| BESEK1 | /S/F/ / | ELIK1 | /S/F/ / | MMBSI1 | /S/I/ / |
| BESI0 | /S/F/ / | ELIPE | /S/F/ / | MMBSJ0 | /S/I/ / |
| BESI1 | /S/F/ / | ELIPK | /S/F/ / | MMBSJ1 | /S/I/ / |
| BESJ0 | /S/F/ / | ELK | /S/M/ / | MMBSK0 | /S/I/ / |
| BESJ1 | /S/F/ / | ELLI | /S/N/*/ | MMBSK1 | /S/I/ / |
| BESK0 | /S/F/ / | ELLIP | /S/N/*/ | MMBSYN | /S/I/ / |
| BESK1 | /S/F/ / | EL3 | /S/M/ / | MMDAW | /S/I/ / |
| BESNIS | /S/M/ / | EONE | /S/F/ / | MMDEI | /S/I/ / |
| BESNKS | /S/M/ / | ERF | /S/M/ / | MMDELE | /S/I/ / |
| BESSI | /S/N/*/ | ERF | /S/N/*/ | MMDELK | /S/I/ / |
| BESSJ | /S/N/*/ | ERFINV | /S/M/ / | MMKELO | /S/I/ / |
| BESSK | /S/N/*/ | ERROR | /S/N/*/ | MMKELO | /S/I/ / |
| BESSY | /S/N/*/ | EXPEI | /S/F/ / | MMKEL1 | /S/I/ / |
| BESY | /S/F/ / | EXPINT | /S/N/*/ | MNORIS | /S/I/ / |
| BSJ | /S/M/ / | FRESNEL | /S/N/N/ | NBESJ | /S/M/ / |
| BSJ | /S/N/N/ | GAMAIN | /S/M/ / | PSI | /S/F/ / |
| CBSF | /S/N/*/ | GAMCAR | /S/N/N/ | PSI | /S/N/*/ |
| CEI3 | /S/N/*/ | GAMMA | /S/M/ / | RBESY | /S/M/ / |
| CEL3 | /S/M/ / | GAMMA | /S/N/N/ | SNCNDN | /S/N/N/ |
| CHEBEV | /S/M/ / | HANKEL | /S/M/ / | VCONVO | /S/I/ / |
| CHTOL | /S/M/ / | LOGGAM | /S/M/ / | YNU | /S/F/ / |
| COMBES | /S/M/ / | LOGGAM | /S/N/*/ | | |
| COMBES | /S/N/*/ | MERF | /S/I/ / | | |

C4 SIMULTANEOUS NON-LINEAR ALGEBRAIC EQUATIONS

| | | | | | |
|---|---|---|---|---|---|
| NEWT | /S/M/ / | NRSG | /S/M/ / | RQNWT | /S/M/ / |
| NONLIQ | /S/M/ / | QNWT | /S/M/ / | ZSYSTM | /S/I/ / |

C5 SIMULTANEOUS TRANSCENDENTAL EQUATIONS

| | | | |
|---|---|---|---|
| QNWT | /S/M/ / | RQNWT | /S/M/ / |

C6 ROOTS OF FUNCTIONS

| | | | | | |
|---|---|---|---|---|---|
| ROOTER | /S/N/*/ | ZANLYT | /S/I/ / | ZREAL1 | /S/I/ / |
| ZAFUJ | /S/M/ / | ZBRENT | /S/I/ / | ZREAL2 | /S/I/ / |
| ZAFUM | /S/M/ / | ZCOUNT | /S/M/ / | | |
| ZAFUR | /S/M/ / | ZFALSE | /S/I/ / | | |

D0 OPERATIONS ON FUNCTIONS AND SOLUTIONS OF DIFFERENTIAL EQUATIONS

| | | | |
|---|---|---|---|
| PADE | /S/M/ / | RATL | /S/M/ / |

D1 NUMERICAL INTEGRATION

| | | | | | |
|---|---|---|---|---|---|
| DBCEVU | /S/I/ / | LAGRAN | /S/M/ / | SIMP | /S/N/*/ |
| DBCQDU | /S/I/ / | LAGUER | /S/M/ / | SIMPRC | /S/M/ / |
| DCADRE | /S/I/ / | LEGEND | /S/M/ / | SIMPUN | /S/N/*/ |
| DCSQDU | /S/I/ / | PARBL | /S/M/ / | TRGINT | /S/M/ / |
| FGI | /S/N/*/ | QUAD | /S/M/ / | UNCSPL | /S/M/ / |
| FNOL3 | /S/N/*/ | QUADG | /S/N/N/ | XFIL | /S/N/*/ |
| GMI | /S/M/ / | ROMBG | /S/M/ / | | |
| HERMIT | /S/M/ / | SICI | /S/M/ / | | |

D2 NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

| | | |
|---|---|---|
| DASCRU /S/I/ / | DVERK /S/I/ / | FNOL3 /S/N/*/ |
| DREBS /S/I/ / | DVOGER /S/I/ / | KUTMER /S/N/N/ |

D3 NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS

| | | |
|---|---|---|
| BLCKDQ /S/M/ / | LINBVP /S/M/ / | RKINIT /S/M/ / |
| BVP /S/M/ / | NRKVS /S/M/ / | |
| DRATEX /S/M/ / | NRKVSH /S/M/ / | |

D4 NUMERICAL DIFFERENTIATION

| | | |
|---|---|---|
| CDERIV /S/M/ / | DERIV /S/M/ / | LAGDIF /S/M/ / |
| DCSEVU /S/I/ / | DIFTAB /S/M/ / | TRGDIF /S/M/ / |

E0 INTERPOLATION AND APPROXIMATIONS

| | | |
|---|---|---|
| COSEVL /S/M/ / | SINEVL /S/M/ / | ZSRCH /S/I/ / |

E1 TABLE LOOK-UP AND INTERPOLATION

| | | |
|---|---|---|
| ACFI /S/M/ / | IBCIEU /S/I/ / | SEARCH /S/M/ / |
| AITKEN /S/M/ / | ICSICU /S/I/ / | SINSER /S/M/ / |
| ATSM /S/M/ / | ICHSCU /S/I/ / | TBLU1 /S/M/ / |
| CRDTAB /S/N/*/ | IRATCU /S/I/ / | TBLU2 /S/M/ / |
| DISCOT /S/N/N/ | LAGINT /S/M/ / | TBLU3 /S/M/ / |
| FRMRAN /S/N/*/ | NRICH /S/M/ / | TERP1 /S/M/ / |
| FRMRA2 /S/N/*/ | ORTHON /S/M/ / | TERP2 /S/M/ / |
| HRMT1 /S/M/ / | PRICH /S/M/ / | TERP3 /S/M/ / |
| HRMT2 /S/M/ / | RICH /S/M/ / | |

E2 CURVE FITTING

| | | |
|---|---|---|
| BSUBHT /S/M/ / | FFT2 /S/I/ / | LSQHTS /S/M/ / |
| CCONGR /S/M/ / | FFT2RV /S/I/ / | LSQSIT /S/M/ / |
| CDECOM /S/M/ / | FFT5 /S/N/*/ | LSQSUB /S/N/*/ |
| CFCME /S/M/ / | FHRNEW /S/M/ / | OPLSA /S/N/N/ |
| CHEBAP /S/M/ / | FITLIN /S/M/ / | ORTHFT /S/M/ / |
| CHEBEV /S/M/ / | FLGNEW /S/M/ / | PLAGR /S/M/ / |
| COMCUB /S/M/ / | FLSQFY /S/M/ / | PLRG /M/R/M/ |
| CUBIC2 /S/M/ / | FOURAP /S/M/ / | POLYN /S/N/N/ |
| CURV /S/M/ / | FOURI /S/M/ / | PRONY /S/M/ / |
| DIFTAB /S/M/ / | GMHAS /S/N/*/ | RFFT /S/N/N/ |
| FCGM2 /S/M/ / | GMI /S/M/ / | RFSN /S/N/N/ |
| FCLSQ /S/M/ / | IBCICU /S/I/ / | SPLFIT /S/N/*/ |
| FDLSQ /S/M/ / | ICSFKU /S/I/ / | SPLINE /S/M/ / |
| FFT /S/N/N/ | ICSVKU /S/I/ / | SQFIT /S/N/*/ |
| FFTP /S/I/ / | ITRLSQ /S/M/ / | SURFS /S/M/ / |
| FFTP /S/I/ / | LSQHTM /S/M/ / | UNCSPL /S/M/ / |

E3 SMOOTHING

| | | |
|---|---|---|
| ICSMOU /S/I/ / | SIGSMT /S/M/ / | SMOOTH /S/N/*/ |
| ICSSCU /S/I/ / | SMOCUB /S/M/ / | |
| MILN2 /S/M/ / | SMOOTH /S/M/ / | |

E4 MINIMIZING OR MAXIMIZING A FUNCTION

| | | |
|---|---|---|
| MIGEN /S/M/ / | MINRAT /S/M/ / | ZXMIN /S/I/ / |
| MINMAX /S/N/*/ | ZXFIB /S/I/ / | ZXSSQ /S/I/ / |

## F1 VECTOR AND MATRIX OPERATIONS

| | | | | | |
|---|---|---|---|---|---|
| AXBS | /S/D/*/ | LU3 | /S/A/ / | VCVTFB | /S/I/ / |
| BALANC | /S/E/ / | LU4 | /S/A/ / | VCVTFQ | /S/I/ / |
| BALANC | /S/M/ / | LU5 | /S/A/ / | VCVTFS | /S/I/ / |
| BANDR | /S/E/ / | LU6 | /S/A/ / | VCVTHC | /S/I/ / |
| BCHSDC | /S/M/ / | MATINS | /S/N/N/ | VCVTQF | /S/I/ / |
| BDCWNP | /S/M/ / | MINFIT | /S/E/ / | VCVTQS | /S/I/ / |
| BDECOM | /S/M/ / | ORTHES | /S/E/ / | VCVTSF | /S/I/ / |
| BDTRGI | /S/I/ / | ORTHO | /S/A/ / | VCVTSQ | /S/I/ / |
| BDTRGO | /S/I/ / | ORTHO2 | /S/A/ / | VHSH2C | /S/I/ / |
| BMD10S | /M/B/ / | ORTRAN | /S/E/ / | VHSH2R | /S/I/ / |
| CBAL | /S/E/ / | PRDSUM | /S/M/ / | VHSH3R | /S/I/ / |
| CDECOM | /S/M/ / | QZHES | /S/E/ / | VIP | /S/M/ / |
| CHSDEC | /S/M/ / | QZIT | /S/E/ / | VIPA | /S/M/ / |
| CINPRD | /S/M/ / | RAYLGH | /S/M/ / | VIPD | /S/M/ / |
| COMHES | /S/E/ / | RLSUBM | /S/I/ / | VIPDA | /S/M/ / |
| CORTH | /S/E/ / | RLSUM | /S/I/ / | VIPDS | /S/M/ / |
| DCBHT | /S/M/ / | SCPF | /S/D/*/ | VIPRFF | /S/I/ / |
| DCWNE | /S/M/ / | SMTVX | /S/M/ / | VIPRSS | /S/I/ / |
| DCWNP | /S/M/ / | SMVX | /S/M/ / | VIPS | /S/M/ / |
| DECOM | /S/M/ / | SPDCOM | /S/M/ / | VMULBB | /S/I/ / |
| EBALAC | /S/I/ / | SUBDIA | /S/M/ / | VMULBF | /S/I/ / |
| EBALAF | /S/I/ / | SUBDIR | /S/M/ / | VMULBS | /S/I/ / |
| ELMHES | /S/E/ / | SUMF | /S/D/*/ | VMULFB | /S/I/ / |
| ELTRAN | /S/E/ / | SVD | /S/A/ / | VMULFF | /S/I/ / |
| FABSV | /S/M/ / | SVD | /S/E/ / | VMULFM | /S/I/ / |
| FCOMB | /S/M/ / | TRED1 | /S/E/ / | VMULFP | /S/I/ / |
| FIGI | /S/E/ / | TRED2 | /S/E/ / | VMULFQ | /S/I/ / |
| FIGI2 | /S/E/ / | TRED3 | /S/E/ / | VMULFS | /S/I/ / |
| FIP | /S/A/ / | TRIDI | /S/M/ / | VMULQB | /S/I/ / |
| FMMX | /S/M/ / | TRI1 | /S/A/ / | VMULQF | /S/I/ / |
| FMTMX | /S/M/ / | TRI2 | /S/A/ / | VMULQQ | /S/I/ / |
| FMTR | /S/M/ / | TRI3 | /S/A/ / | VMULQS | /S/I/ / |
| FMTVCX | /S/M/ / | TRI4 | /S/A/ / | VMULSB | /S/I/ / |
| FMTVX | /S/M/ / | USCRDM | /S/I/ / | VMULSF | /S/I/ / |
| FMVCX | /S/M/ / | USMNMX | /S/I/ / | VMULSQ | /S/I/ / |
| FMVX | /S/M/ / | USRDM | /S/I/ / | VMULSS | /S/I/ / |
| FNORM1 | /S/M/ / | USRDV | /S/I/ / | VNRMFI | /S/I/ / |
| FPUR | /S/M/ / | USWB | /S/I/ / | VNRMF1 | /S/I/ / |
| HSSN | /S/M/ / | USWBSM | /S/I/ / | VNRMF2 | /S/I/ / |
| HTRIDI | /S/E/ / | USWLFM | /S/I/ / | VNRMS1 | /S/I/ / |
| HTRID3 | /S/E/ / | USWLSM | /S/I/ / | VNRMS2 | /S/I/ / |
| INRPRD | /S/M/ / | USWTFM | /S/I/ / | VPOLYF | /S/I/ / |
| INVS | /S/D/*/ | USWTFV | /S/I/ / | VTPROF | /S/I/ / |
| ITERIN | /S/M/ / | USWTSM | /S/I/ / | VTPROS | /S/I/ / |
| LEQT1B | /S/I/ / | USWTSV | /S/I/ / | VTRAN | /S/I/ / |
| LEQT1C | /S/I/ / | VABMXF | /S/I/ / | VUABQ | /S/I/ / |
| LEQT2B | /S/I/ / | VABMXS | /S/I/ / | VUAFB | /S/I/ / |
| LEQT2C | /S/I/ / | VABSMF | /S/I/ / | VUAFQ | /S/I/ / |
| LEQ1S | /S/I/ / | VABSMS | /S/I/ / | VUAFS | /S/I/ / |
| LEQ2S | /S/I/ / | VCONVO | /S/I/ / | VUASB | /S/I/ / |
| LU1 | /S/A/ / | VCVTBF | /S/I/ / | VUASQ | /S/I/ / |
| LU2 | /S/A/ / | VCVTCH | /S/I/ / | | |

F2 EIGENVALUES AND EIGENVECTORS

| | | | | | |
|---|---|---|---|---|---|
| AEVS | /S/D/*/ | EIGRS | /S/I/ / | RECOV1 | /S/M/ / |
| BAC1 | /S/A/ / | EIGSYM | /S/M/ / | RECOV2 | /S/M/ / |
| BAC2 | /S/A/ / | EIGVCH | /S/M/ / | REDSY1 | /S/M/ / |
| BAKVEC | /S/E/ / | EIGZC | /S/I/ / | REDSY2 | /S/M/ / |
| BALBAK | /S/E/ / | EIGZF | /S/I/ / | REDUC | /S/E/ / |
| BANDV | /S/E/ / | EIGS | /S/M/ / | REDUC1 | /S/A/ / |
| BANEIG | /S/M/ / | ELMBAK | /S/E/ / | REDUC2 | /S/E/ / |
| BISEC | /S/A/ / | ELRH1C | /S/I/ / | RG | /S/E/ / |
| BISECT | /S/E/ / | ELRH2C | /S/I/ / | RGG | /S/E/ / |
| BQR | /S/E/ / | ELZHC | /S/I/ / | RITZIT | /S/A/ / |
| CBABK2 | /S/E/ / | ELZVC | /S/I/ / | RNQL1 | /S/A/ / |
| CG | /S/E/ / | EQRH1F | /S/I/ / | RS | /S/E/ / |
| CH | /S/E/ / | EQRH3F | /S/I/ / | RSB | /S/E/ / |
| CINVIT | /S/E/ / | EQRT1S | /S/I/ / | RSG | /S/E/ / |
| COMBAK | /S/E/ / | EQRT2S | /S/I/ / | RSGAB | /S/E/ / |
| COMLR | /S/E/ / | EQRT3S | /S/I/ / | RSGBA | /S/E/ / |
| COMLR2 | /S/E/ / | EQZQF | /S/I/ / | RSP | /S/E/ / |
| COMQR | /S/E/ / | EQZTF | /S/I/ / | RST | /S/E/ / |
| COMQR2 | /S/E/ / | EQZVF | /S/I/ / | RT | /S/E/ / |
| CORTB | /S/E/ / | HQR | /S/E/ / | SEPAR | /S/M/ / |
| DEIG | /S/M/ / | HQR2 | /S/E/ / | SEPAR2 | /S/M/ / |
| DTSHFT | /S/M/ / | HTRIBK | /S/E/ / | SEVS | /S/D/*/ |
| EBALAC | /S/I/ / | HTRIB3 | /S/E/ / | SIMP | /S/M/ / |
| EBALAF | /S/I/ / | IMQL1 | /S/A/ / | SYMLR | /S/M/ / |
| EBBCKC | /S/I/ / | IMTQLV | /S/E/ / | SYMQR | /S/M/ / |
| EBBCKF | /S/I/ / | IMTQL1 | /S/E/ / | TCOIAG | /S/M/ / |
| EHBCKF | /S/I/ / | IMTQL2 | /S/E/ / | TINVIT | /S/E/ / |
| EHBCKH | /S/I/ / | INIT | /S/A/ / | TQLRAT | /S/E/ / |
| EHESSC | /S/I/ / | INVIT | /S/E/ / | TQL1 | /S/E/ / |
| EHESSF | /S/I/ / | LATNTR | /S/M/ / | TQL2 | /S/E/ / |
| EHOBKS | /S/I/ / | ORTBAK | /S/E/ / | TRBAK1 | /S/E/ / |
| EHOUSH | /S/I/ / | QREIGN | /S/M/ / | TRBAK3 | /S/E/ / |
| EHOUSS | /S/I/ / | QZABX | /S/A/ / | TRIDIB | /S/E/ / |
| EIGCC | /S/I/ / | QZVAL | /S/E/ / | TSTURM | /S/E/ / |
| EIGCH | /S/I/ / | QZVEC | /S/E/ / | VALVEC | /S/M/ / |
| EIGCHK | /S/M/ / | RATQR | /S/E/ / | VARAH1 | /S/N/*/ |
| EIGCO1 | /S/M/ / | REBAK | /S/E/ / | VARAH2 | /S/N/*/ |
| EIGIMP | /S/M/ / | REBAKA | /S/A/ / | VECTOR | /S/M/ / |
| EIGRF | /S/I/ / | REBAKB | /S/E/ / | | |

F3 DETERMINANTS

| | | | | | |
|---|---|---|---|---|---|
| BPOSOM | /S/M/ / | LINSYS | /S/M/ / | MATINS | /S/N/N/ |
| DETERM | /S/M/ / | LINV3F | /S/I/ / | PDITRM | /S/M/ / |
| GAUSS | /S/N/N/ | LINV3P | /S/I/ / | PDITRS | /S/M/ / |
| LEQWNE | /S/M/ / | LITWNE | /S/M/ / | SPITRM | /S/M/ / |
| LEQWNP | /S/M/ / | LITWNP | /S/M/ / | SPITRS | /S/M/ / |

## F4 SIMULTANEOUS LINEAR EQUATIONS

BFBANP /S/M/ /
BFBSUM /S/M/ /
BITERM /S/M/ /
BITREM /S/M/ /
BITRNP /S/M/ /
BITRPD /S/M/ /
BITWNP /S/M/ /
BLESOM /S/M/ /
BLSWNP /S/M/ /
BMAM /S/N/*/
BPDITM /S/M/ /
BPDSFB /S/M/ /
BPDSOM /S/M/ /
BSUBHT /S/M/ /
CCONGR /S/M/ /
CFBSUM /S/M/ /
CGAUSS /S/N/N/
CGITRF /S/M/ /
CGLESM /S/M/ /
CITERF /S/M/ /
CMPINV /S/N/N/
FBSUBM /S/M/ /
FBSUBS /S/M/ /
FCGM2 /S/M/ /
GAUSS /S/N/N/
GITREM /S/M/ /
GITRES /S/M/ /
GLESOM /S/M/ /
GLESOS /S/M/ /
IMPR1 /S/A/ /
IMPR2 /S/A/ /
INVERS /S/M/ /
INVITR /S/M/ /
ITEREM /S/M/ /
ITERES /S/M/ /
ITRPDM /S/M/ /
ITRPDS /S/M/ /
ITRSPM /S/M/ /
ITRSPS /S/M/ /
LEQS1 /S/A/ /
LEQS2 /S/A/ /
LEQS3 /S/A/ /
LEQS4 /S/A/ /
LEQS5 /S/A/ /
LEQS6 /S/A/ /
LEQT1B /S/I/ /
LEQT1C /S/I/ /
LEQT1F /S/I/ /
LEQT1P /S/I/ /
LEQT2B /S/I/ /
LEQT2C /S/I/ /
LEQT2F /S/I/ /
LEQT2P /S/I/ /
LEQ1PB /S/I/ /
LEQ1S /S/I/ /
LEQ2PB /S/I/ /
LEQ2S /S/I/ /
LESWNE /S/M/ /
LESWNP /S/M/ /
LINSYS /S/M/ /
LINV1F /S/I/ /
LINV1P /S/I/ /
LINV2F /S/I/ /
LINV2P /S/I/ /
LINV3F /S/I/ /
LINV3P /S/I/ /
LIN1PB /S/I/ /
LIN2PB /S/I/ /
LITWNE /S/M/ /
LITWNP /S/M/ /
LLSQAR /S/I/ /
LPSDOR /S/I/ /
LSQHTM /S/M/ /
LSQHTS /S/M/ /
LSQSIT /S/M/ /
LSVALR /S/I/ /
LUDAPB /S/I/ /
LUDATF /S/I/ /
LUDECP /S/I/ /
LUELMF /S/I/ /
LUELMP /S/I/ /
LUELPB /S/I/ /
LUREFF /S/I/ /
LUREFP /S/I/ /
LUREPB /S/I/ /
MAM /S/N/*/
MAM200 /S/N/*/
MATINS /S/N/N/
OFIMA3 /S/I/ /
ORIMP /S/A/ /
ORSOL /S/A/ /
PDITRM /S/M/ /
PDITRS /S/M/ /
PDLSOM /S/M/ /
PDLSOS /S/M/ /
PDSFBM /S/M/ /
PDSFBS /S/M/ /
QR1 /S/M/ /
RQNWT /S/M/ /
SCONG /S/M/ /
SPDFBM /S/M/ /
SPDFBS /S/M/ /
SPDSOM /S/M/ /
SPDSOS /S/M/ /
SPITRM /S/M/ /
SPITRS /S/M/ /
TRDCNP /S/M/ /
TRDCOM /S/M/ /
TRDFBM /S/M/ /
TRDSOM /S/M/ /
TRDSUB /S/M/ /
TRDWNP /S/M/ /
TRILOM /S/M/ /
TRILOS /S/M/ /
TRIUPM /S/M/ /
TRIUPS /S/M/ /
TRLOIN /S/M/ /
TRUPIN /S/M/ /

## G0 STATISTICAL ANALYSIS AND PROBABILITY

BMD01S /M/B/ /
BMD03S /M/B/ /
BMD09S /M/B/ /
BMD10S /M/B/ /
BMD11S /M/B/ /
BMD12S /M/B/ /
BMD13S /M/B/ /
BMD14S /M/B/ /
EDIT /D/S/ /
OMNITAB/M/ /R/
USLEAP /S/I/ /
USRDVM /S/I/ /
USTREE /S/I/ /
ZRMN /S/M/ /

G1 DATA REDUCTION (COMMON STATISTICAL PARAMETERS)

AGGREGA/D/S/ /
AGLMOD /S/I/ /
AMEANS /S/I/ /
AORDR /S/I/ /
BDCOU1 /S/I/ /
BDCOU2 /S/I/ /
BECORI /S/I/ /
BECORO /S/I/ /
BECOVM /S/I/ /
BECVLI /S/I/ /
BECVLO /S/I/ /
BEGRPS /S/I/ /
BEIGRP /S/I/ /
BEIUGR /S/I/ /
BELBIN /S/I/ /
BELPOS /S/I/ /
BEMIRI /S/I/ /
BEMIRO /S/I/ /
BEMMI /S/I/ /
BEMMO /S/I/ /
BMDP1D /M/C/ /
BMDP2D /M/C/ /
BMDP3D /M/C/ /
BMDP4D /M/C/ /
BMDP5D /M/C/ /
BMDP6D /M/C/ /
BMDP7D /M/C/ /
BMDP8D /M/C/ /
BMDP9D /M/C/ /
BMD01D /M/B/ /
BMD04D /M/B/ /
BMD05D /M/B/ /
BMD06D /M/B/ /
BMD07D /M/B/ /
BMD10D /M/B/ /
BMD11D /M/B/ /
BMD13D /M/B/ /
BREAKDO/D/S/ /
CONDESC/D/S/ /
CONTAB /S/D/*/
CORREL /S/D/*/
CORS /S/D/*/
DISTAT /S/D/*/
DLETE /S/M/ /
DSCRPT /S/M/ /
DSCRP2 /S/M/ /
FILTER /S/M/ /
FREQCY /S/D/*/
FREQUEN/D/S/ /
GTMN /S/I/ /
GTMN1 /S/I/ /
OP1RAY /S/M/ /
OP2RAY /S/M/ /
SSPAND /S/I/ /
SSPBLK /S/I/ /
SSRAND /S/I/ /
SSRBLK /S/I/ /
SSSAND /S/I/ /
SSSBLK /S/I/ /
SSSCAN /S/I/ /
SSSEST /S/I/ /
STUTEE /S/N/*/
T-TEST /D/S/ /
TTESTS /S/D/*/
USHIST /S/I/ /
USHIUT /S/I/ /
USHV1 /S/I/ /

G2 CORRELATION AND REGRESSION ANALYSIS

BECTR /S/I/ /
BEMIRI /S/I/ /
BEMIRO /S/I/ /
BESRB /S/I/ /
BESRN /S/I/ /
BMDP1R /M/C/ /
BMDP2R /M/C/ /
BMDP3R /M/C/ /
BMDP4R /M/C/ /
BMDP5R /M/C/ /
BMDP6R /M/C/ /
BMD01R /M/B/ /
BMD02D /M/B/ /
BMD02R /M/B/ /
BMD03D /M/B/ /
BMD03R /M/B/ /
BMD04R /M/B/ /
BMD05R /M/B/ /
BMD06R /M/B/ /
BMD07R /M/B/ /
BMD09M /M/B/ /
BMD12D /M/B/ /
CANONA /S/D/*/
CBNRHO /S/I/ /
CORCOV /S/M/ /
CORREL /S/D/*/
CORS /S/D/*/
CTBNLL /S/I/ /
DSCRIM /S/D/*/
G3SLS /D/S/ /
LAGCOR /S/D/*/
LSQHTM /S/M/ /
LSQHTS /S/M/ /
LSQSIT /S/M/ /
MDRS /S/D/*/
NONLINE/D/S/ /
NONPAR /D/S/ /
OFRESI /S/I/ /
PARTIAL/D/S/ /
PEARSON/D/S/ /
PLOT /D/S/ /
REGRAN /S/D/*/
REGRESS/D/S/ /
RLCOMP /S/I/ /
RLOCQM /S/I/ /
RLOCVA /S/I/ /
RLOCW /S/I/ /
RLOOPM /S/I/ /
RLEAP /S/I/ /
RLFITI /S/I/ /
RLFITO /S/I/ /
RLFOR /S/I/ /
RLFORC /S/I/ /
RLFOTH /S/I/ /
RLFOTW /S/I/ /
RLGQMI /S/I/ /
RLGQMO /S/I/ /
RLINCF /S/I/ /
RLINPF /S/I/ /
RLMUL /S/I/ /
RLONE /S/I/ /
RLOPOC /S/I/ /
RLPOLY /S/I/ /
RLPOL1 /S/I/ /
RLPRDI /S/I/ /
RLPRDO /S/I/ /
RLRES /S/I/ /
RLSEP /S/I/ /
RLSTEP /S/I/ /
RSMITZ /S/I/ /
RSMSSE /S/I/ /
SCATTER/D/S/ /
TORS /S/D/*/
TETRACH/D/S/ /

G4 ANALYSIS OF VARIANCE

| | | |
|---|---|---|
| ABALAT /S/I/ / | ANESTU /S/I/ / | BMD02V /M/B/ / |
| ABIBAN /S/I/ / | ANOVA /D/S/ / | BMD03V /M/B/ / |
| ACRDAN /S/I/ / | ANOVAR /S/D/*/ | BMD04V /M/B/ / |
| ACTRST /S/I/ / | ANOVA1 /S/N/*/ | BMD05V /M/B/ / |
| AFACAN /S/I/ / | ANOVA2 /S/N/*/ | BMD06V /M/B/ / |
| AFACMN /S/I/ / | AORDR /S/I/ / | BMD07V /M/B/ / |
| AFACT /S/I/ / | ARCSAN /S/I/ / | BMD08V /M/B/ / |
| AGBACP /S/I/ / | ASNKMC /S/I/ / | BMD09V /M/B/ / |
| AGLMOD /S/I/ / | AVAR23 /S/D/*/ | BMD10V /M/B/ / |
| AGVACL /S/I/ / | AVTRND /S/D/*/ | BMD11V /M/B/ / |
| AGXPMN /S/I/ / | BETWEEN/S/D/*/ | BMD12V /M/B/ / |
| AGXPMS /S/I/ / | BETWITH/S/D/*/ | BRTLTT /S/M/ / |
| ALSQAN /S/I/ / | BMDP1V /M/C/ / | DISTAT /S/D/*/ |
| AMEANS /S/I/ / | BMDP2V /M/C/ / | MANOVA /D/S/ / |
| ANCOV1 /S/I/ / | BMDP7D /M/C/ / | ONEWAY /D/S/ / |
| ANESTE /S/I/ / | BMD01V /M/B/ / | WITHIN /S/D/*/ |

G5 TIME SERIES

| | | |
|---|---|---|
| BMD01T /M/B/ / | FTARPS /S/I/ / | FTKALM /S/I/ / |
| BMD02T /M/B/ / | FTAUTO /S/I/ / | FTMAPS /S/I/ / |
| BMD03T /M/B/ / | FTCAST /S/I/ / | FTMAXL /S/I/ / |
| BMD04T /M/B/ / | FTCOMP /S/I/ / | FTRDIF /S/I/ / |
| BMD05T /M/B/ / | FTCROS /S/I/ / | FTSIMP /S/I/ / |
| FFCSIN /S/I/ / | FTCRXY /S/I/ / | FTTRAN /S/I/ / |
| FFTP /S/I/ / | FTFFT1 /S/I/ / | FTWEIN /S/I/ / |
| FFTR /S/I/ / | FTFREQ /S/I/ / | FTWENM /S/I/ / |
| FFT2 /S/I/ / | FTFUNC /S/I/ / | FTWENX /S/I/ / |
| FFT2RV /S/I/ / | FTGEN1 /S/I/ / | HARM /S/M/ / |

G6 SPECIAL FUNCTIONS (INCLUDES RANDOM NUMBERS AND PDF'S)

| | | |
|---|---|---|
| BETAR /S/M/ / | GTPKP /S/I/ / | PFDIST /S/M/ / |
| BMDP1S /M/C/ / | GTPL /S/I/ / | PGEOM /S/M/ / |
| CHICHI /S/D/*/ | GTPOK /S/I/ / | PGMMA /S/M/ / |
| CHIDST /S/M/ / | GTPRT /S/I/ / | PHYPGE /S/M/ / |
| CHIPRB /S/M/ / | GTPST /S/I/ / | PIBETA /S/M/ / |
| CHIPAB /S/M/ / | GTRN /S/I/ / | PIBIN /S/M/ / |
| CHIRUD /S/M/ / | GTRT /S/I/ / | PICHI /S/M/ / |
| CHSQQ /S/M/ / | GTRTM /S/I/ / | PICHY /S/M/ / |
| CONRAY /S/M/ / | GTSRT /S/I/ / | PIEXP /S/M/ / |
| EXRAND /S/M/ / | GTTRT /S/I/ / | PIFDIS /S/M/ / |
| GFTT /S/I/ / | GTTT /S/I/ / | PIGAMA /S/M/ / |
| GGAMA /S/I/ / | IAOC /S/N/*/ | PIGEO /S/M/ / |
| GGBIN /S/I/ / | IDAYWEK/S/N/*/ | PIHYPG /S/M/ / |
| GGBNB /S/I/ / | IRAND /S/M/ / | PILGNM /S/M/ / |
| GGBTA /S/I/ / | MDBETA /S/I/ / | PINBIN /S/M/ / |
| GGCAU /S/I/ / | MDBETI /S/I/ / | PINORM /S/M/ / |
| GGCSS /S/I/ / | MDBIN /S/I/ / | PIPOIS /S/M/ / |
| GGEOM /S/I/ / | MDBONR /S/I/ / | PIRAYL /S/M/ / |
| GGEXP /S/I/ / | MDCH /S/I/ / | PIS /S/M/ / |
| GGHYP /S/I/ / | MDCHI /S/I/ / | PIT /S/M/ / |
| GGMUL /S/I/ / | MDFD /S/I/ / | PITRNM /S/M/ / |
| GGNLN /S/I/ / | MDFDRE /S/I/ / | PIUNF /S/M/ / |
| GGNMP /S/I/ / | MDFI /S/I/ / | PIUNFD /S/M/ / |

G6 SPECIAL FUNCTIONS (CONTINUED)

| | | |
|---|---|---|
| GGNOF /S/I/ / | MDGAM /S/I/ / | PIWEBL /S/M/ / |
| GGNOR /S/I/ / | MDHYP /S/I/ / | PLGNRM /S/M/ / |
| GGNRM /S/I/ / | MDNOR /S/I/ / | PNBIN /S/M/ / |
| GGNRM1 /S/I/ / | MDPOS /S/I/ / | PNORM /S/M/ / |
| GGPOSH /S/I/ / | MDSMR /S/I/ / | PORAND /S/M/ / |
| GGPOSR /S/I/ / | MDSTI /S/I/ / | PRAYL /S/M/ / |
| GGSPR /S/I/ / | MDTD /S/I/ / | PRBEXP /S/M/ / |
| GGTMAJ /S/I/ / | MDTN /S/I/ / | PRBF /S/D/*/ |
| GGTMA1 /S/I/ / | MDTNF /S/I/ / | PRBUNF /S/M/ / |
| GGTMA2 /S/I/ / | MDTPOS /S/I/ / | PTDIST /S/M/ / |
| GGTRI /S/I/ / | MNORIS /S/I/ / | PTRNRM /S/M/ / |
| GGUB /S/I/ / | MSMRAT /S/I/ / | PUNFD /S/M/ / |
| GGUBF /S/I/ / | NDMPLE /S/I/ / | PWEBL /S/M/ / |
| GGU4 /S/I/ / | NDXEST /S/I/ / | RAND /S/M/ / |
| GGVACR /S/I/ / | NONPAR /D/S/ / | RANNUM /S/N/*/ |
| GGWEI /S/I/ / | NRAND /S/M/ / | RUNSAB /S/M/ / |
| GTDD /S/I/ / | NRML /S/M/ / | RUNSUD /S/M/ / |
| GTDD1 /S/I/ / | NRMNO /S/M/ / | URAND /S/M/ / |
| GTD2T /S/I/ / | PBETA /S/M/ / | USPC /S/I/ / |
| GTNOR /S/I/ / | PBINOM /S/M/ / | USPDF /S/I/ / |
| GTPBC /S/I/ / | PCHY /S/M/ / | XIRAND /S/M/ / |

G7 MULTIVARIATE ANALYSIS AND SCALE STATISTICS

| | | |
|---|---|---|
| AFACT /S/I/ / | BMD07M /M/B/ / | OFHARR /S/I/ / |
| BMDP1M /M/C/ / | BMD07S /M/B/ / | OFIMAG /S/I/ / |
| BMDP2M /M/C/ / | BMD08M /M/B/ / | OFPRIN /S/I/ / |
| BMDP3M /M/C/ / | BMD08S /M/B/ / | OFPROT /S/I/ / |
| BMDP4M /M/C/ / | BMD09M /M/B/ / | OFROTA /S/I/ / |
| BMDP6M /M/C/ / | BMD10M /M/B/ / | OFSCHN /S/I/ / |
| BMDP7M /M/C/ / | CANCORR/D/S/ / | OFSCOR /S/I/ / |
| BMD01M /M/B/ / | DISCRIM/D/S/ / | OPRINC /S/I/ / |
| BMD02M /M/B/ / | FACTOR /D/S/ / | OTMLNR /S/I/ / |
| BMD03M /M/B/ / | FACTOR /S/D/*/ | RELATE /S/D/*/ |
| BMD04M /M/B/ / | GUTTMAN/D/S/ / | RELIABI/D/S/ / |
| BMD04S /M/B/ / | HGROUP /S/D/*/ | TESTAT /S/D/*/ |
| BMD05M /M/B/ / | JFACTOR/D/S/ / | TSCALE /S/D/*/ |
| BMD05S /M/B/ / | OCLINK /S/I/ / | VORS /S/D/*/ |
| BMD06M /M/B/ / | OFCOEF /S/I/ / | |
| BMD06S /M/B/ / | OFCOMM /S/I/ / | |

G8 NON-PARAMETRIC METHODS AND STATISTICAL TESTS

| | | |
|---|---|---|
| BMDP1F /M/C/ / | NBQT /S/I/ / | NMRANK /S/I/ / |
| BMDP3S /M/C/ / | NBSD /S/I/ / | NMTIE /S/I/ / |
| BMD02S /M/B/ / | NBSIGN /S/I/ / | NONPAR /D/S/ / |
| BMD08D /M/B/ / | NBSL /S/I/ / | NPAR /D/S/ / |
| BMD09D /M/B/ / | NDMPLE /S/I/ / | NRBHA /S/I/ / |
| CROSSTA/D/S/ / | NHEXT /S/I/ / | NRWMP /S/I/ / |
| NAK1 /S/I/ / | NHINC /S/I/ / | NRWRST /S/I/ / |
| NAWNRP /S/I/ / | NMCC /S/I/ / | NSK1 /S/I/ / |
| NAWRPE /S/I/ / | NMKEN /S/I/ / | NSK2 /S/I/ / |
| NAWRPU /S/I/ / | NMKSF /S/I/ / | SUMMARY/D/S/ / |
| NBCYC /S/I/ / | NMKST /S/I/ / | |

G9 STATISTICAL INFERENCE

| | | |
|---|---|---|
| AGVACL /S/I/ / | BEPATN /S/I/ / | CTRBYC /S/I/ / |
| ASNKMC /S/I/ / | BEPATS /S/I/ / | GTCN /S/I/ / |
| BFMNON /S/I/ / | BEPETN /S/I/ / | OIND /S/I/ / |
| BFMSON /S/I/ / | BEPETS /S/I/ / | |
| BENSON /S/I/ / | CONTAB /S/D/*/ | |

H1 LINEAR PROGRAMMING

| | | |
|---|---|---|
| ZX1LP /S/I/ / | ZX2LP /S/I/ / | ZX3LP /S/I/ / |

H3 TRANSPORTATION AND NETWORK CODES

| | |
|---|---|
| PERTC /M/ /R/ | PERTIME/M/ /R/ |

H4 SIMULATION MODELING

| | |
|---|---|
| GPSS /M/ /R/ | SIMII5 /M/ /R/ |
| MIMIC /M/ /R/ | SIMI5 /M/ /R/ |

I0 INPUT

| |
|---|
| FASTIN /S/N/*/ |

I2 OCTAL

| | |
|---|---|
| OFMTDE /S/N/N/ | OFMTV /S/N/N/ |

I3 DECIMAL

| | | |
|---|---|---|
| CROTAB /S/N/*/ | USRDM /S/I/ / | USRDVM /S/I/ / |
| USCRDM /S/I/ / | USRDV /S/I/ / | |

I4 BCD (HOLLERITH)

| | | |
|---|---|---|
| ICOM /S/N/*/ | ICOMN /S/N/*/ | IFMTV /S/N/N/ |

I9 COMPOSITE

| | |
|---|---|
| RECOVRD/S/N/N/ | START /S/M/ / |

J0 OUTPUT

| |
|---|
| MPSCM /M/U/U/ |

J1 BINARY

| | |
|---|---|
| CV29 /M/U/U/ | CV29 /P/P/P/ |

J2 OCTAL

| |
|---|
| PRTFL /S/N/N/ |

J3 DECIMAL

| | | |
|---|---|---|
| PCDS /S/D/*/ | USRDVM /S/I/ / | USWTFM /S/I/ / |
| PRTS /S/D/*/ | USWB /S/I/ / | USWTFV /S/I/ / |
| PTMS /S/D/*/ | USWBSM /S/I/ / | USWTSM /S/I/ / |
| SUBS /S/D/*/ | USWLFM /S/I/ / | USWTSV /S/I/ / |
| USLFAP /S/I/ / | USWLSM /S/I/ / | |

J4 BCD (HOLLERITH)

| | | |
|---|---|---|
| BANR /S/N/N/ | LINE6 /P/P/P/ | PM /P/P/P/ |
| COPYSF /M/ /R/ | LINE6 /S/N/N/ | PRTIME /S/N/N/ |
| ICOM /S/N/*/ | LINE8 /P/P/P/ | |
| ICOMN /S/N/*/ | LINE8 /S/N/N/ | |

J5 PLOTTING

| | | |
|---|---|---|
| BMDP5D /M/C/ / | PLOTMY /S/N/*/ | USHIUT /S/I/ / |
| BMDP6D /M/C/ / | PLOTPR /S/N/N/ | USHV1 /S/I/ / |
| BMDP7D /M/C/ / | PLOTXY /S/N/*/ | USPC /S/I/ / |
| BMD05D /M/B/ / | SCATTER/D/S/ / | USPDF /S/I/ / |
| CALCOMP/S/ /R/ | SCCALC /S/ /R/ | USPLH /S/I/ / |
| CALC3D /P/P/P/ | SC4020 /S/ /R/ | USPLX /S/I/ / |
| DISSPLA/S/ /R/ | SC4060 /S/ /R/ | USTREE /S/I/ / |
| HSTGRM /S/M/ / | TEKTRNX/S/ /R/ | XPLOT /S/M/ / |
| PLOT /D/S/ / | USHIST /S/I/ / | XYPLOT /S/M/ / |

J9 COMPOSITE

| | | |
|---|---|---|
| HEXDMP /M/U/U/ | PRUDMP /M/U/U/ | TAPDMP /M/U/U/ |

K1 EXTERNAL-TO-EXTERNAL

| | | |
|---|---|---|
| COPYE /M/ /R/ | COPYS /M/ /R/ | PROMNT /M/U/U/ |
| COPYF /M/ /R/ | COPYS /P/P/P/ | RECADD /P/P/P/ |
| COPYR /M/ /R/ | COPYSEL/M/U/U/ | RECDELE/P/P/P/ |
| COPYRE /M/U/U/ | COPYSF /M/ /R/ | RECGET /P/P/P/ |
| COPYRM /M/ /R/ | CVT360 /M/ /R/ | RECREPL/P/P/P/ |

K2 INTERNAL-TO-INTERNAL (RELOCATION)

| | | |
|---|---|---|
| GETPA /S/N/*/ | MSET /3/N/N/ | |
| MFETCH /S/N/N/ | RCPA /S/N/N/ | |

K3 DISK

| | | |
|---|---|---|
| COPYL /M/ /R/ | GETOBJ /M/U/U/ | UPDGET /P/P/P/ |
| COPYLIB/M/U/U/ | PRUDMP /M/U/U/ | UPDGETS/P/P/P/ |
| COPYLIB/P/P/P/ | SELDUMP/P/P/P/ | UPDGETT/P/P/P/ |
| COPYN /M/ /R/ | TRANPAK/P/P/P/ | UPDREPL/P/P/P/ |
| CRINDEX/P/P/P/ | UPDADD /P/P/P/ | |
| DOCUMNT/M/U/U/ | UPDDELE/P/P/P/ | |

K4 TAPE

| | | |
|---|---|---|
| COPYBFR/M/ /R/ | HEXDMP /M/U/U/ | TAPDMP /M/U/U/ |
| COPYBLK/P/P/P/ | SELLOAD/P/P/P/ | |

L2 COMPILING

| | | |
|---|---|---|
| ALGOL /M/ /R/ | PASCAL /M/ /R/ | RUNMNF /P/P/P/ |
| BASIC /M/ /R/ | PL1 /M/ /R/ | RUNSEQ /P/P/P/ |
| COBOL /M/ /R/ | RUN /M/ /R/ | RUNTS /P/P/P/ |
| FTN /M/ /R/ | RUNBAS /P/P/P/ | SNOBOL /M/ /R/ |
| MNF /M/ /*/ | RUNFTN /P/P/P/ | |

L3 MONITORING

| | |
|---|---|
| COMPASS/M/ /R/ | COMRADE/M/ /R/ |

L4 PREPROCESSING

| | |
|---|---|
| RATFOR /M/ /*/ | TIDY /M/ /R/ |

L7 COMPUTER LANGUAGE TRANSLATORS

| |
|---|
| LCS /M/ /R/ |

M0 DATA HANDLING

| | | |
|---|---|---|
| COMPSTR/S/N/*/ | EQU60 /S/N/N/ | MASKIT /S/N/N/ |

M1 SORTING

| | | |
|---|---|---|
| ASORT /S/N/N/ | QSORT /S/N/N/ | VARORD /S/M/ / |
| ASORTMV/S/N/N/ | QSORT1 /S/N/N/ | VECORD /S/M/ / |
| AUDIT /P/P/P/ | SORTMRG/M/ /R/ | VSORTA /S/I/ / |
| AUDSORT/M/U/U/ | SSORT /S/N/N/ | VSORTM /S/I/ / |
| BMD14S /M/B/ / | SSORTF /S/N/N/ | VSORTP /S/I/ / |
| DEKSORT/M/U/U/ | SSORTI /S/N/N/ | VSORTZ /S/I/ / |
| HSTGRM /S/M/ / | SSORTL /S/N/N/ | VSRTPM /S/I/ / |

M2 CONVERSION AND/OR SCALING

| | | |
|---|---|---|
| BMD09S /M/B/ / | GETHOUR/S/N/N/ | MONTH /S/N/N/ |
| BMD12S /M/B/ / | IHMS /S/N/N/ | NEWDAT /S/N/N/ |
| BMD13S /M/B/ / | IROMAN /S/N/N/ | TIDY /M/ /R/ |
| CVT360 /M/ /R/ | ISEC /S/N/N/ | WEKDAY /S/N/N/ |
| CV29 /M/U/U/ | JGDATE /S/N/N/ | |
| CV29 /P/P/P/ | JULIAN /S/N/N/ | |

M3 MERGING

SORTMRG/M/ /R/

M4 CHARACTER MANIPULATION

| | | |
|---|---|---|
| ADJL /S/N/N/ | GETPRM /S/N/*/ | SBYT /S/N/N/ |
| ADJR /S/N/N/ | IBUNP /S/N/*/ | SEMICO /S/N/N/ |
| ASHIFT /S/N/N/ | IPAKLFT/S/N/N/ | SENT /S/N/*/ |
| CENTER /S/N/N/ | ISTAPE /S/N/N/ | SETREW /S/N/N/ |
| CHFILL /S/N/N/ | LBYT /S/N/N/ | SHIFTA /S/N/N/ |
| CONTRCT/S/N/*/ | LEFTADJ/S/N/N/ | SKWEZL /S/N/N/ |
| COPYEXT/M/U/U/ | MOVSTR /S/N/N/ | SKWEZR /S/N/N/ |
| EXPAND /S/N/*/ | PARGET /S/N/N/ | TRAILBZ/S/N/N/ |
| EXPRM /S/N/*/ | PUTCHA /S/N/N/ | VALDAT /S/N/N/ |
| EXTBIT /S/N/N/ | PUTCHR /S/N/N/ | VFILL /S/N/N/ |
| EXTPRM /S/N/N/ | REPLAC /S/N/N/ | ZBLANK /S/N/N/ |
| FBINRD /S/N/*/ | REPLACM/S/N/N/ | ZEROES /S/N/*/ |
| FORMATR/M/U/U/ | REPLHI /S/N/N/ | ZEROFL /S/N/N/ |
| GETCHA /S/N/N/ | REPLLO /S/N/N/ | ZEROS /S/N/N/ |
| GETCHR /S/N/N/ | REPLNE /S/N/N/ | |

M5 SEARCHING, SEEKING, LOCATING

| | | |
|---|---|---|
| AMAXE /S/N/N/ | GETCHR /S/N/N/ | MINE /S/N/N/ |
| AMINE /S/N/N/ | IDIGIT /S/N/N/ | NFILLT /S/N/N/ |
| FINDC /S/N/N/ | IFINDCH/S/N/N/ | NUMVAR /S/N/*/ |
| FINDW /S/N/N/ | LASTC /S/N/N/ | VALIDT /S/N/N/ |
| FINDWRD/S/N/N/ | LASTWRD/S/N/N/ | |
| GETCHA /S/N/N/ | MAXE /S/N/N/ | |

M6 REPORT GENERATORS

| | |
|---|---|
| QU /M/ /R/ | SCOPE /M/ /R/ |

N0 DEBUGGING

| | |
|---|---|
| ALTIME /S/N/N/ | MONERR /S/F/ / |
| ELTIME /S/N/N/ | PRTIME /S/N/N/ |

N1 TRACING AND TRAPPING

ING /S/D/*/

N2 DUMPING

| | | |
|---|---|---|
| DMPA /S/N/N/ | DMPFIT /S/N/N/ | DUMPFIT/S/N/N/ |
| DMPCPA /S/N/N/ | DUMPA /S/N/N/ | DUMPFL /S/N/N/ |
| DMPFIL /M/U/U/ | DUMPCPA/S/N/N/ | RECOVRD/S/N/N/ |

Q1 OFF-LINE EQUIPMENT

| | | |
|---|---|---|
| CARDS /M/U/U/ | CV29 /M/U/U/ | LIST3 /M/U/U/ |
| CARDS2 /M/U/U/ | CV29 /P/P/P/ | LIST4 /M/U/U/ |
| CCIRM /P/P/P/ | DOCDOC /P/P/P/ | PAGEPRT/M/U/U/ |
| CCLIB /P/P/P/ | LINERL /M/U/U/ | PRODOC /P/P/P/ |
| CCRM /M/U/U/ | LISTCMP/M/U/U/ | RECDOC /P/P/P/ |
| CCRM /P/P/P/ | LISTEOI/M/U/U/ | TIDBITS/P/P/P/ |
| COPYEXT/M/U/U/ | LISTZ /M/U/U/ | UPDDOC /P/P/P/ |
| COPYRE /M/U/U/ | LIST1 /M/U/U/ | |
| COPYSEL/M/U/U/ | LIST2 /M/U/U/ | |

P0 DIAGNOSTICS (HARDWARE MALFUNCTION)

| | | |
|---|---|---|
| VERTST /S/I/ / | | |

Q0 SERVICE OR HOUSEKEEPING, PROGRAMMING AIDS

| | | |
|---|---|---|
| AC /S/N/N/ | IDID /S/N/N/ | PRTFL /S/N/N/ |
| ALTIME /S/N/N/ | ISITCNF/S/N/N/ | PTIM /M/U/U/ |
| AUDSORT/M/U/U/ | JOBNAME/S/N/N/ | REDUCE /S/N/N/ |
| BANNER /M/U/U/ | JOBORG /S/N/N/ | SEND /P/P/P/ |
| BANNER3/M/U/U/ | JOBTIME/M/U/U/ | SKPSTAT/S/N/N/ |
| BDT /P/P/P/ | LINER /M/U/U/ | WHATLIB/M/U/U/ |
| DFDATIM/M/U/U/ | LINERL /M/U/U/ | WHATLIB/P/P/P/ |
| ELTIME /S/N/N/ | MACHINE/S/N/N/ | WHICHMF/M/U/U/ |
| FTNRFL /S/N/N/ | MFX /P/P/P/ | WHICHOS/M/U/U/ |
| GETFIT /S/N/N/ | NORERUN/P/P/P/ | ZPFPUT /S/N/N/ |
| GETLFNS/S/N/N/ | NUMEXEC/S/N/N/ | ZRTPUT /S/N/N/ |
| GODROP /S/N/*/ | OVLNAME/S/N/N/ | |
| HERE /S/N/N/ | PFRC /S/N/N/ | |

Q3 FILE MANIPULATION

| | | |
|---|---|---|
| REQUEST/S/N/N/ | S2K260 /P/P/P/ | ZPFUNC /S/N/N/ |
| ROUTE /S/N/N/ | S2000 /P/P/P/ | ZSYSEQ /S/N/N/ |
| SKPFIL /S/N/N/ | UNLOAD /S/N/N/ | |

Q4 INTERNAL HOUSEKEEPING, SAVE, RESTORE, ETC.

| | | |
|---|---|---|
| OBUTIL /M/ /R/ | PRTIME /S/N/N/ | SELDUMP/P/P/P/ |
| NUMVAR /S/N/*/ | RENAMAC/P/P/P/ | SELLOAD/P/P/P/ |

Q6 PROGRAM DOCUMENTATION: FLOW CHARTS, DOCUMENT, STANDARDIZATION

| | | |
|---|---|---|
| DOC /M/U/U/ | DOCREPL/P/P/P/ | PGMTAPE/P/P/P/ |
| DOCADD /P/P/P/ | DOCTAPE/P/P/P/ | PROGDOC/M/U/U/ |
| DOCDELE/P/P/P/ | DOCUMNT/M/U/U/ | PURPOSE/M/U/U/ |
| DOCFILE/P/P/P/ | EXECARD/M/U/U/ | STRUCT /P/P/P/ |
| DOCGET /P/P/P/ | MANYDOC/M/U/U/ | TAPLIST/M/U/U/ |
| DOCIT /M/U/U/ | MTDOC /M/U/U/ | UNDOCIT/M/U/U/ |
| DOCLIST/P/P/P/ | PFDOC /M/U/U/ | |

Q7 PROGRAM LIBRARY UTILITIES

| | | |
|---|---|---|
| ANYLIB /P/P/P/ | LISTBIN/M/U/U/ | PROREPL/P/P/P/ |
| ANYPRO /P/P/P/ | LISTCMP/M/U/U/ | REDECK /M/U/U/ |
| BINDEX /M/U/U/ | MNSRDC /P/P/P/ | SORTUP /M/U/U/ |
| COPYL /M/ /R/ | MYPRO /P/P/P/ | UPDADD /P/P/P/ |
| COPYLIB/P/P/P/ | NOGO /P/P/P/ | UPDATE /M/ /R/ |
| COPYN /M/ /R/ | PPOADD /P/P/P/ | UPDDELE/P/P/P/ |
| CPINDEX/P/P/P/ | PROALL /P/P/P/ | UPDGET /P/P/P/ |
| DECK /M/U/U/ | PRODELE/P/P/P/ | UPDGETS/P/P/P/ |
| DECKLST/M/U/U/ | PROGET /P/P/P/ | UPDGETT/P/P/P/ |
| DEKSORT/M/U/U/ | PROGRAM/P/P/P/ | UPDLIST/P/P/P/ |
| EDITLIB/M/ /R/ | PROHDR /P/P/P/ | UPDREPL/P/P/P/ |
| ITEMIZE/M/ /R/ | PROLIST/P/P/P/ | UTILITY/P/P/P/ |
| LIBSET1/P/P/P/ | PROMNT /M/U/U/ | |
| LIBSET2/P/P/P/ | PRONAM /P/P/P/ | |

R1 FORMAL LOGIC

| | | |
|---|---|---|
| COUPLE /S/N/*/ | XOR /S/N/*/ | |

R3 LTST AND STRING PROCESSING

| | | |
|---|---|---|
| SNOBOL /M/ /R/ | | |

R4 TEXT EDITING

| | | |
|---|---|---|
| EDITOR /M/ /R/ | NETED /M/ /*/ | |
| FORMATR/M/U/U/ | RNF /M/ /*/ | |

S0 INFORMATION RETRIEVAL

| | | |
|---|---|---|
| AUDIT /P/P/P/ | GRIPE /P/P/P/ | RIQS /M/ /R/ |
| COMRADE/M/ /R/ | MARS /M/ /R/ | SHARP /M/ /R/ |
| DBUTIL /M/ /R/ | PAGEPRT/M/U/U/ | S2000 /M/ /R/ |
| DDL /M/ /R/ | PURPOSE/M/U/U/ | TAPLIST/M/U/U/ |
| DMS170 /M/ /R/ | QQ /M/ /R/ | VENUS /M/ /R/ |
| EXECARD/M/U/U/ | QU /M/ /R/ | VENUS /P/P/P/ |

T4 ENGINEERING

| | | |
|---|---|---|
| AROCFT /S/N/*/ | ECAP /M/ /R/ | STRESS /M/ /R/ |
| CIVCO /M/ /R/ | NASTRAN/M/ /R/ | |

T6 MANUFACTURING (NON-DATA) PROCESSING AND PROCESS CONTROL

| | |
|---|---|
| APT /M/ /P/ | |

V1 RANDOM NUMBER GENERATORS

| | | |
|---|---|---|
| EXRAND /S/M/ / | NRMNO /S/M/ / | URAND /S/M/ / |
| IRAND /S/M/ / | PORAND /S/M/ / | XIRAND /S/M/ / |
| NRAND /S/M/ / | RAND /S/M/ / | |
| NRML /S/M/ / | RANNUM /S/N/*/ | |

V2 COMBINATORIAL GENERATORS: PERMUTATIONS, COMBINATIONS & SUBSETS

| | |
|---|---|
| FFPDR2 /S/I/ / | |

Z0 ALL OTHERS

| | |
|---|---|
| SSP /S/ /R/ | |

## ***** PROGRAMS *****

THE COMPUTER CENTER CURRENTLY MAINTAINS FOUR LIBRARIES OF MAIN PROGRAMS IN ABSOLUTE FORM:

1) BIMED - SOME OF THE BMD BIOMEDICAL STATISTICAL PROGRAMS
2) BIMEDP - SOME OF THE BMDP BIOMEDICAL STATISTICAL PROGRAMS
3) MNSRDC - LOCALLY WRITTEN AND/OR SUPPORTED SCIENTIFIC PROGRAMS
4) UTILITY - LOCALLY WRITTEN AND/OR SUPPORTED UTILITIES

THERE ARE ALSO SOME MAIN PROGRAMS, INCLUDING SPSS AND CVT360, WHICH ARE MAINTAINED IN SEPARATE FILES.

## *** BIMED ***

THE FOLLOWING IS A LIST OF THE UCLA BIOMEDICAL STATISTICAL PROGRAMS. THOSE WITH AN ASTERISK (*) ARE AVAILABLE IN LIBRARY 'BIMED'. SOME OF THE OTHERS MAY BE ADDED IF REQUESTED.

REFERENCE: BMD BIOMEDICAL COMPUTER PROGRAMS, W. J. DIXON, EDITOR, UNIVERSITY OF CALIFORNIA PRESS, BERKELEY, 1973.

| | | |
|---|---|---|
| BMD01D | | SIMPLE DATA DESCRIPTION |
| BMD02D | | CORRELATION WITH TRANSGENERATION |
| BMD03D | * | CORRELATION WITH ITEM DELETION |
| BMD04D | | ALPHANUMERIC FREQUENCY COUNT |
| BMD05D | * | GENERAL PLOT INCLUDING HISTOGRAM |
| BMD06D | | DESCRIPTION OF STRATA |
| BMD07D | | DESCRIPTION OF STRATA WITH HISTOGRAMS |
| BMD08D | | CROSS-TABULATION WITH VARIABLE STACKING |
| BMD09D | | CROSS-TABULATION, INCOMPLETE DATA |
| BMD10D | | DATA PATTERNS FOR DICHOTOMIES |
| BMD11D | | DATA PATTERNS FOR POLYCHOTOMIES |
| BMD12D | | ASYMMETRIC CORRELATION WITH MISSING DATA |
| BMD13D | | T PROGRAM |
| | | |
| BMD01M | | PRINCIPAL COMPONENT ANALYSIS |
| BMD02M | | REGRESSION ON PRINCIPAL COMPONENTS |
| BMD03M | | FACTOR ANALYSIS |
| BMD04M | | DISCRIMINANT ANALYSIS FOR TWO GROUPS |
| BMD05M | * | DISCRIMINANT ANALYSIS FOR SEVERAL GROUPS |
| BMD06M | | CANONICAL ANALYSIS |
| BMD07M | | STEPWISE DISCRIMINANT ANALYSIS |
| BMD08M | | FACTOR ANALYSIS |
| BMD09M | | CANONICAL CORRELATION ANALYSIS |
| BMD10M | | IDENTIFICATION OF OUTLIERS |

| | | |
|---|---|---|
| BMD01R | | SIMPLE LINEAR REGRESSION |
| BMD02R | | STEPWISE REGRESSION |
| BMD03R | * | MULTIPLE REGRESSION WITH CASE COMBINATIONS |
| BMD04R | * | PERIODIC REGRESSION AND HARMONIC ANALYSIS |
| BMD05R | * | POLYNOMIAL REGRESSION |
| BMD06R | | ASYMPTOTIC REGRESSION |
| BMD07R | * | NON-LINEAR LEAST SQUARES |
| | | |
| BMD01S | | LIFE TABLE AND SURVIVAL RATE |
| BMD02S | | CONTINGENCY TABLE ANALYSIS |
| BMD03S | | BIOLOGICAL ASSAY: PROBIT ANALYSIS |
| BMD04S | | GUTTMAN SCALE PREPROCESSOR |
| BMD05S | | GUTTMAN SCALE # 1 |
| BMD06S | | GUTTMAN SCALE # 2, PART 1 |
| BMD07S | | GUTTMAN SCALE # 2, PART 2 |
| BMD08S | | GUTTMAN SCALE # 2, PART 3 |
| BMD09S | | TRANSGENERATION |
| BMD10S | | TRANSPOSITION OF LARGE MATRICES |
| BMD11S | | LIFE TABLE AND SURVIVAL RATE (NO. 2) |
| BMD12S | | OPEN-ENDED TRANSGENERATION |
| BMD13S | | MULTIPASS TRANSGENERATION |
| BMD14S | | GENERALIZED SORTING ROUTINE |
| | | |
| BMD01T | | AMPLITUDE AND PHASE ANALYSIS |
| BMD02T | | AUTOCOVARIANCE AND POWER SPECTRAL ANALYSIS |
| BMD03T | | TIME SERIES SPECTRUM ESTIMATION |
| BMD04T | | MULTIPLE TIME SERIES SPECTRAL ANALYSIS |
| BMD05T | | TIME-LOCKED AVERAGING |
| | | |
| BMD01V | | ANALYSIS OF VARIANCE FOR ONE-WAY DESIGN |
| BMD02V | | ANALYSIS OF VARIANCE FOR FACTORIAL DESIGN |
| BMD03V | | ANALYSIS OF COVARIANCE FOR FACTORIAL DESIGN |
| BMD04V | | ANALYSIS OF COVARIANCE WITH MULTIPLE COVARIATES |
| BMD05V | | GENERAL LINEAR HYPOTHESIS |
| BMD06V | | GENERAL LINEAR HYPOTHESIS WITH CONTRASTS |
| BMD07V | | MULTIPLE RANGE TESTS |
| BMD08V | | ANALYSIS OF VARIANCE |
| BMD09V | | ANALYSIS OF COVARIANCE |
| BMD10V | | GENERAL LINEAR HYPOTHESIS (NO. 2) |
| BMD11V | | MULTIVARIATE GENERAL LINEAR HYPOTHESIS |
| BMD12V | * | MULTIVARIATE ANALYSIS OF VARIANCE AND COVARIANCE |

## *** BIMEDP ***

THE FOLLOWING IS A LIST OF THE UCLA BIOMEDICAL STATISTICAL PROGRAMS (P-SERIES). THOSE WITH AN ASTERISK (*) ARE AVAILABLE IN LIBRARY 'BIMEDP'. SOME OF THE OTHERS MAY BE ADDED IF REQUESTED.

REFERENCE: BMDP BIOMEDICAL COMPUTER PROGRAMS, W. J. DIXON, EDITOR, UNIVERSITY OF CALIFORNIA PRESS, BERKELEY, 1975.

| | |
|---|---|
| BMDP1D | SIMPLE DATA DESCRIPTION |
| BMDP2D | FREQUENCY COUNT ROUTINE |
| BMDP3D | T TEST AND T-SQUARED ROUTINE |
| BMDP4D | ALPHANUMERIC FREQUENCY COUNT ROUTINE |
| BMDP5D | UNIVARIATE PLOTTING |
| BMDP6D | BIVARIATE PLOTTING |
| BMDP7D | DESCRIPTION OF STRATA WITH HISTOGRAMS AND ANALYSIS OF VARIANCE |
| BMDP8D | MISSING VALUE CORRELATION |
| BMDP9D | MULTIDIMENSIONAL DATA DESCRIPTION |
| BMDP1F | TWO-WAY CONTINGENCY TABLES |
| BMDP1M | CLUSTER ANALYSIS ON VARIABLES |
| BMDP2M | CLUSTER ANALYSIS ON CASES |
| BMDP3M | BLOCK CLUSTERING |
| BMDP4M | FACTOR ANALYSIS |
| BMDP6M | CANONICAL CORRELATION ANALYSIS |
| BMDP7M | STEPWISE DISCRIMINANT ANALYSIS |
| BMDP1R | MULTIPLE LINEAR REGRESSION |
| BMDP2R | STEPWISE REGRESSION |
| BMDP3R | NONLINEAR REGRESSION |
| BMDP4R | REGRESSION ON PRINCIPAL COMPONENTS |
| BMDP5R | POLYNOMIAL REGRESSION |
| BMDP6R | PARTIAL CORRELATION AND MULTIVARIATE REGRESSION |
| BMDP1S | MULTIPASS TRANSFORMATION |
| BMDP3S | NONPARAMETRIC STATISTICS |
| BMDP1V | ONE-WAY ANALYSIS OF VARIANCE AND COVARIANCE |
| BMDP2V | ANALYSIS OF VARIANCE AND COVARIANCE, INCLUDING REPEATED MEASURES |

## *** MNSRDC ***

THE COMPUTER CENTER MAINTAINS SOME LOCALLY WRITTEN AND/OR SUPPORTED SCIENTIFIC PROGRAMS IN THE PUBLIC ACCESS LIBRARY CALLED 'MNSRDC'. PROGRAMS IN THE LIBRARY MAY BE EXECUTED IN ONE OF THE FOLLOWING WAYS:

A) ATTACH,MNSRDC.
LIBRARY,MNSRDC. OR LDSET,LIB=MNSRDC.
PROG,<PARAMETERS>. WHERE PROG IS THE DESIRED PROGRAM

B) BEGIN,MNSRDC,,PROG,<PARAMETERS>.

REFERENCE: CCLIB/M. BECAUSE THERE ONLY TWO ROUTINES IN MNSRDC, ONLY A COMPUTER COPY OF THE MANUAL IS AVAILABLE. WHEN THERE IS A SUFFICIENT NUMBER OF ROUTINES IN MNSRDC, CCLIB/M WILL BE PUBLISHED FORMALLY. ADDITIONS TO THE LIBRARY ARE WELCOME.

LIBRARY 'MNSRDC' CONTAINS THE FOLLOWING PROGRAM:

| | |
|---|---|
| PLRG | POLYNOMIAL REGRESSION (IBM SSP SAMPLE PROGRAM MODIFIED) |
| POLYMUL | ROOTS OF A POLYNOMIAL WITH COMPLEX COEFFICIENTS BY MULLER'S METHOD |

## *** SPSS ***

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES (SPSS) IS AN OPEN-ENDED INTEGRATED SYSTEM OF STATISTICAL PROGRAMS EMBEDDED IN A SINGLE CONTROL PROGRAM. THE CDC 6000 VERSION WAS OBTAINED FROM NORTHWESTERN UNIVERSITY AND IS MAINTAINED BY ONE OF OUR CUSTOMERS (THE CONSTRUCTION ENGINEERING RESEARCH LABORATORY (CERL), COMPUTER SERVICES BRANCH). SPSS IS A BATCH SYSTEM WRITTEN MOSTLY IN FORTRAN. THIS PACKAGE (VERSION 6) IS MORE VERSATILE THAN THE BIMED ROUTINES (PAGE 2-1), SINCE MANY DIFFERENT STATISTICS CAN BE PERFORMED ON THE SAME DATA IN ONE RUN.

REFERENCES: "SPSS, SECOND EDITION", NIE, HULL, JENKINS, STEINBRENNER AND BENT, MCGRAW-HILL, 1975.

"SPSS PRIMER", KLECKA, NIE AND HULL, MCGRAW-HILL, 1975.

'SPSS' CONTAINS THE FOLLOWING DATA-CARD-CALLABLE PROCEDURES:

| | |
|---|---|
| AGGREGATE | DESCRIPTIVE GROUP STATISTICS FOR SPECIFIED VARIABLES WRITTEN TO RAW OUTPUT FILE |
| ANOVA | ONE- TO FIVE-WAY ANALYSIS OF VARIANCE AND COVARIANCE FOR FACTORIAL DESIGNS |
| BREAKDOWN | DESCRIPTIVE STATISTICS ON SUBGROUPS |
| CANCORR | CANONICAL CORRELATION ANALYSIS AND TESTS OF STATISTICAL SIGNIFICANCE |
| CONDESCRIPTIVE | DESCRIPTIVE STATISTICS FOR CONTINUOUS (UNGROUPED) VARIABLES |
| CROSSTABS | 2-WAY TO N-WAY JOINT FREQUENCY DISTRIBUTION, CONTINGENCY TABLES AND RELATED MEASURES OF ASSOCIATION |
| DISCRIMINANT | MULTIPLE DISCRIMINANT ANALYSIS IN STEPWISE OR DIRECT MODE |
| FACTOR | FACTOR ANALYSIS BY ONE OF FIVE DIFFERENT METHODS |
| FREQUENCIES | ONE-WAY FREQUENCY DISTRIBUTIONS WITH DESCRIPTIVE STATISTICS |
| GUTTMAN SCALE | UP TO 50 SEPARATE GUTTMAN SCALES BY VARIANT OF GOOD ENOUGH TECHNIQUE |
| G3SLS | GENERALIZED AND 3-STAGE LEAST SQUARES ESTIMATES OF THE PARAMETERS OF A SYSTEM OF SIMULTANEOUS STOCHASTIC EQUATIONS |
| JFACTOR | JORESKOG FACTOR ANALYSIS FOR GENERALIZED LEAST SQUARES, MAXIMUM LIKELIHOOD, AND UNWEIGHTED LEAST SQUARES |
| MANOVA | MULTIVARIATE ANALYSIS OF VARIANCE AND COVARIANCE WITH UNEQUAL CELL FREQUENCIES |

| | |
|---|---|
| NONLINEAR | NONLINEAR REGRESSION BY MINIMIZING SUMS OF SQUARES |
| NONPAR CORR | SPEARMAN AND/OR KENDALL RANK-ORDER CORRELATION COEFFICIENTS AND LEVEL OF SIGNIFICANCE |
| NPAR TESTS | 13 NONPARAMETRIC STATISTICAL TESTS |
| ONEWAY | ONE-WAY ANALYSIS OF VARIANCE WITH RANGE TESTS |
| PARTIAL CORR | UP TO 25 SETS OF PARTIAL CORRELATIONS OF ANY ORDER OR COMBINATION - LEAST SQUARES REGRESSION IN MULTIPLE OR STEPWISE MODE |
| PEARSON CORR | PEARSON PRODUCT-MOMENT (ZERO-LEVEL) CORRELATION COEFFICIENTS AND LEVEL OF SIGNIFICANCE |
| RELIABILITY | COEFFICIENTS OF RELIABILITY AND OTHER SUMMARY STATISTICS FOR EVALUATING MULTIPLE ITEM SCALES |
| SCATTERGRAM | SCATTER DIAGRAM OF DATA POINTS AND SIMPLE REGRESSION |
| SUMMARY TABLES | TABLES (PERCENTAGES AND OPTIONAL CELL COUNTS) WHICH SUMMARIZE RELATIONSHIPS BETWEEN INDEPENDENT VARIABLE AND A NUMBER OF DICHOTOMOUS DEPENDENT VARIABLES |
| TETRACHORIC | TETRACHORIC CORRELATION COEFFICIENTS BETWEEN DICHOTOMOUS VARIABLES |
| T-TEST | STUDENT'S T AND PROBABILITY LEVELS TESTS ON SAMPLE MEANS |

## *** UTILITY ***

THE COMPUTER CENTER MAINTAINS SOME LOCALLY WRITTEN AND/OR SUPPORTED UTILITIES IN THE PUBLIC ACCESS LIBRARY CALLED 'UTILITY'. PROGRAMS IN THIS LIBRARY MAY BE EXECUTED IN ONE OF THE FOLLOWING WAYS:

A) ATTACH,UTILITY.
LIBRARY,UTILITY. OR LDSET,LIB=UTILITY.
PROG,<PARAMETERS>. WHERE PROG IS THE DESIRED PROGRAM

B) BEGIN,UTILITY,,PROG,<PARAMETERS>.

REFERENCES: ALL OF THESE PROGRAMS ARE DOCUMENTED IN CCLIB/U, WHICH MAY BE OBTAINED FROM USER SERVICES.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROGRAM 'PROGDOC' (SEE PAGE 1-2).

LIBRARY 'UTILITY' CONTAINS THE FOLLOWING PROGRAMS:

| | |
|---|---|
| AUDSORT | PRINT SORTED AUDIT |
| BANNER | PRINT A BANNER (PAGE) |
| BANNER3 | PRINT 3 BANNERS ON ONE PAGE |
| BINDEX | GIVE LIST AND SORTED LIST OF OUTPUT OF EDITLIB 'LISTLIB' AND 'CONTENT' DIRECTIVES |
| CARDS | REPRODUCE A BCD DECK WITH MODIFICATONS (FIELDS MAY BE MOVED, DELETED, INTERCHANGED, GANG PUNCHED AND/OR SEQUENCED) |
| CARDS2 | REPRODUCE A BCD DECK WITH MODIFICATIONS (FIELDS MAY BE COPIED, MOVED, DELETED, INTERCHANGED, GANG PUNCHED AND/OR SEQUENCED) |
| CCRM | EXTRACT ALL PAGES FROM COMPUTER CENTER REFERENCE MANUAL WHICH WERE MODIFIED AFTER USER-SPECIFIED DATE |
| COPYEXT | COPY UNIT RECORDS (ZERO BYTE TERMINATED) EXTRACTING SPECIFIED COLUMNS AND OPTIONALLY MOVING THEM AND OPTIONALLY ADD EDITOR SEQUENCING |
| COPYLIB | FROM AN EDITLIB LISTLIB LISTING, CREATE SORTED (OR UNSORTED) DIRECTIVES TO COPY AN EDITLIB USER LIBRARY |
| COPYRE | COPY AND REARRANGE FILE OF ZERO BYTE TERMINATED RECORDS (150 CHARACTERS MAXIMUM PER RECORD) |
| COPYSEL | COPY AND REARRANGE FILE OF ZERO BYTE TERMINATED RECORDS (150 CHARACTERS MAXIMUM PER RECORD; FILE PROCESSED DIRECTLY) |
| CV29 | CONVERT TO 029 PUNCH CODE |

DECK LIST UPDATE 'SOURCE' FILE DECK/COMDECK NAMES, SEQUENCE NUMBER AND NUMBER OF CARDS

DECKLST LIST UPDATE 'SOURCE' FILE DECK/COMDECK NAMES, SEQUENCE NUMBER, NUMBER OF CARDS, NUMBER OF LINES AND PAGES (IF COLUMN 1 CARRIAGE CONTROL IS USED) (LIST CONTENTS OF A DOCUMENTATION FILE)

DEKSORT SORT IDENT AND DECK LISTINGS FROM UPDATE OUTPUT FILE

DFDATIM PUT DATE/TIME IN DAYFILE

DMPFIL DUMP FIRST N WORDS OF EACH LOGICAL RECORD IN M FILES

DOC PREPARE (SUB)PROGRAM AND CATALOGUED PROCEDURE DOCUMENTATION

DOCIT ADD PAGING TO A DOCUMENT

DOCUMNT MAINTAIN A FILE OF DOCUMENTS

EXECARD EXTRACT EXECUTE CARD PARAMETER/SUBPROGRAM USAGE/PROCEDURE USAGE INFORMATION FROM DOCUMENTATION FILES (WHICH WERE PREPARED IN THE FORMAT GENERATED BY PROGRAM 'DOC')

FORMATR THIS IS A TEXT FORMATTER. IT IS DESIGNED TO BE OF ASSISTANCE TO THE PERSON WHO NEEDS TO MANIPULATE TEXT FILES WHICH ARE NOT INHERENTLY LINE ORIENTED. IT WILL ACCEPT FREE-FORM INPUT AND GENERATE FORMATTED OUTPUT UTILIZING ARBITRARILY SIZED RECORDS. THE INPUT CONSISTS OF TEXT AND OPTIONAL DIRECTIVES WHICH CONTROL SUCH FUNCTIONS AS PARAGRAPH INDENTING AND LINE SPACING.

GETOBJ EXTRACT ONE OBJECT MODULE FROM A SEQUENTIAL OBJECT FILE OR AN EDITLIB USER LIBRARY

HEXDMP DUMP 9-TRACK TAPE IN HEXADECIMAL FORMAT

JOBTIME PUT JOB CP EXECUTION TIME TO THIS POINT INTO DAYFILE

LINER COUNT LINES AND PAGES OF A FILE HAVING FIRST CHARACTER CARRIAGE CONTROL

LINERL LIST A DOCUMENT (CARRIAGE CONTROL IN COLUMN 1, ZERO BYTE TERMINATED RECORDS) WITH RECORD COUNT AND COUNT OF LINES ON EACH PAGE (LIST THRU END-OF-INFORMATION)

LISTBIN LIST RELOCATABLE BINARY MODULES IN ONE OR MORE FILES

LISTCMP LIST AN UPDATE COMPILE FILE, EACH DECK BEGINNING ON A NEW PAGE WITH A BANNER PAGE PRECEDING IT

LISTEOI LIST A FILE INSERTING *EOR, *EOF, *EOI WHERE APPROPRIATE

LISTZ LIST ZERO BYTE TERMINATED RECORDS (UP TO 110 CHARACTERS PER RECORD) WITH RECORD NUMBER AND RECORD LENGTHS

LIST1 LIST (CENTERED) ONE COPY OF CARDS (UP TO 90 CHARACTERS) HAVING CARRIAGE CONTROL IN COLUMN 1. OPTIONALLY PRINT CARD, PAGE AND LINE COUNTS AND LINE LENGTHS.

LIST2 SINGLE/DOUBLE SPACE LISTING, 6 OR 8 LINES PER INCH, WITH OPTIONAL SKIP OVER PERFORATION AT BOTTOM OF PAGE (FIRST 120 CHARACTERS)

LIST3 LIST FIRST (UP TO 90-CHARACTER, ZERO BYTE TERMINATED) RECORD IN EACH LOGICAL RECORD THROUGH EOI

LIST4 LIST UNIT RECORDS, THRU EOI, WHICH HAVE '1' IN COLUMN 1

MANYDOC EXTRACT (PRINT) TWO OR MORE DOCUMENTS FROM A DOCUMENTATION FILE

MPSCM CONVERT PRINTED OUTPUT DATA INTO A COM FORMATTED TAPE TO PRODUCE MICROFICHE ON THE DATAGRAPHIX 4530 SYSTEM

MTDOC CREATE DOCUMENTATION TO DESCRIBE THE CONTENTS OF A MAGNETIC TAPE

PAGEPRT PRINT SELECTED PAGE(S) FROM A DOCUMENT

PFDOC CREATE PERMANENT FILE DOCUMENTATION

PROGDOC EXTRACT (PRINT) ONE OR ALL DOCUMENT(S) FROM A DOCUMENTATION FILE

PROMNT MAINTAIN AN ALPHABETICAL, SEQUENTIAL PROCEDURE FILE, EACH PROCEDURE BEING ONE SCOPE LOGICAL RECORD

PRUDMP OCTAL AND CHARACTER DUMP OF DISK FILE BY RELATIVE PRU NUMBER

PTIM PRINT CPA, CPB, CPA+CPB, IO AND PP TIMES SINCE START OF JOB OR INTERCOM SESSION

PURPOSE EXTRACT PURPOSE INFORMATION FROM DOCUMENTATION FILES (WHICH WERE PREPARED IN THE FORMAT GENERATED BY PROGRAM 'DOC')

REDECK CHANGE AN UPDATE COMPILE FILE BACK INTO A SOURCE FILE

SORTUP GENERATE UPDATE DIRECTIVES TO SORT OLDPL

TAPDMP DUMP SELECTED PORTIONS OF A 7-TRACK MAGNETIC TAPE WRITTEN IN AN UNKNOWN DENSITY AND/OR MODE. IT IS CONTROLLED BY A SERIES OF FREE-FIELD CONTROL CARDS CONTAINING ORDERS FOR THE DUMPING, SKIPPING OR BACKSPACING OF RECORDS OR FILES.

TAPLIST PREPARE TWO LISTS FROM MAGTAPEDOCUMENTATION FILE:
1) TAPE NUMBER, LABEL, DENSITY, REMARKS AND DESCRIPTION FOR EACH TAPE DOCUMENTED IN FILE
2) LIST OF TAPE NUMBERS AND LABELS

| | |
|---|---|
| UNDOCIT | REMOVE THE PAGING WHICH WAS ADDED TO A DOCUMENT BY PROGRAM 'DOCIT' |
| WHATLIB | LIST LIBRARIES SPECIFIED ON LAST LIBRARY CARD |
| WHICHMF | TELL TELETYPE USER WHICH MAINFRAME HE IS USING |
| WHICHOS | TELL TELETYPE USER WHICH OPERATING SYSTEM HE IS USING |

## *** PROGRAMS NOT IN LIBRARIES ***

SEVERAL PROGRAMS WHICH ARE NOT IN LIBRARIES ARE LISTED BELOW. (SEE THEIR INDIVIDUAL DOCUMENTS FOR ATTACH AND EXECUTE INFORMATION.)

INDIVIDUAL DOCUMENTS MAY BE PRINTED BY:

BEGIN,UTILITY,,PROGDOC,OTHER,,<PROG>,OUTPUT.

WHERE <PROG> IS THE NAME OF THE PROGRAM WHOSE DOCUMENTATION IS DESIRED. THE LENGTH OF EACH DOCUMENT IS GIVEN IN PARENTHESES.

BEGIN — HOW TO WRITE AND EXECUTE A CATALOGUED PROCEDURE (29 PAGES)

COPYBFR * — RECREATE A CDC 'RANDOM' FILE FROM DATA COPIED EARLIER TO A SEQUENTIAL FILE, OR COPY A RANDOM FILE. IT MAY BE USED TO RECREATE A PROPER OLDPL IF COPYBF WAS USED ERRONEOUSLY. (2 PAGES)

COPYF * — COPY A FILE TO END-OF-INFORMATION (2 PAGES)

COPYF * — COPY BINARY OR CODED FILES (2 PAGES)

COPYR * — COPY BINARY OR CODED RECORDS (2 PAGES)

COPYRM * — COPY AND CONVERT RECORDS ON SEQUENTIAL (SQ) FILES FROM ONE RECORD TYPE AND BLOCK STRUCTURE TO ANOTHER (2 PAGES)

COPYS — A GENERAL PURPOSE UTILITY FROM NORTHWESTERN UNIVERSITY WHICH PROVIDES A LARGE VARIETY OF COPY OPERATIONS FOR SEQUENTIAL OR RANDOM FILES (3 PAGES)

COPYSF * — COPY FILES OR RECORDS WITH OPTIONAL SHIFT TO RIGHT (3 PAGES)

CVT360 — CONVERT DOUBLE PRECISION S/360 FORTRAN PROGRAMS TO SINGLE PRECISION CDC FORTRAN (1 PAGE)

MNF — MINNESOTA FORTRAN (MNF) IS AN ALTERNATIVE COMPILER WHICH COMPILES FASTER THAN FTN AND HAS MORE DIAGNOSTICS AND SIMPLER DEBUG FACILITIES (8 PAGES AT 8 LINES PER INCH)

NETED — AN ELEMENTARY TEXT EDITOR HAVING SOME FEATURES NOT AVAILABLE IN THE INTERCOM EDITOR (20 PAGES)

RATFOR — PRE-COMPILER TO CONVERT RATIONAL FORTRAN TEXT INTO CDC FTN TEXT. RATIONAL FORTRAN IS A PROGRAMMING LANGUAGE WHICH HAS THE STRUCTURE FORMING STATEMENTS THAT ALLOW 'TOP DOWN' AND 'GO TO-LESS' PROGRAMMING. (12 PAGES)

RNF — TEXT FORMATTING PROGRAM PROVIDING ANY OR ALL OF: PAGINATION, LINE FILLING, RIGHT MARGIN JUSTIFICATION, CHAPTERING, SECTIONING, NUMBERED LISTS AND SUBLISTS, MACRO FACILITY. (PORTIONS OF THIS MANUAL WERE PREPARED USING RNF) (47 PAGES)

* - CCRM HAS SUFFICIENT INFORMATION TO EXECUTE THESE PROGRAMS. THE DOCUMENTS CONTAIN ADDITIONAL PARAMETERS AND OTHER INFORMATION.

# ***** SUBPROGRAMS *****

THE COMPUTER CENTER MAINTAINS SEVERAL LIBRARIES OF SUBPROGRAMS IN RELOCATABLE OBJECT FORM. THIS CHAPTER DESCRIBES THE FOLLOWING LIBRARIES AND LISTS THE CONTENTS OF EACH WITH DESCRIPTIVE TITLES (REFERENCES ARE GIVEN FOR THE WRITE-UPS):

ARLNALG - AEROSPACE RESEARCH LABORATORIES LINEAR ALGEBRA LIBRARY
EDSTAT - EDSTAT-P AND EDSTAT-V ROUTINES FOR STATISTICAL ANALYSIS OF BEHAVIORIAL SCIENCE DATA
EISPACK - SOLVE EIGENVALUE AND EIGENVECTOR PROBLEMS
FUNPACK - SPECIAL FUNCTIONAL SUBROUTINE PACKAGE FROM ARGONNE NATIONAL LABORATORY
IMSL - INTERNATIONAL MATHEMATICAL AND STATISTICAL LIBRARIES PACKAGE
MSL - CDC MATH SCIENCE LIBRARY
NSRDC - DTNSRDC WRITTEN AND/OR SUPPORTED SCIENTIFIC AND UTILITY SUBROUTINES

THESE ROUTINES ARE USED PRIMARILY WITH FTN, MNF OR RATFOR PROGRAMS AND MOST ARE CODED IN FTN.

TO ACCESS ANY LIBRARY:

```
ATTACH,<LIB>.
LDSET,LIB=<LIB>.          OR        LIBRARY,<LIB>.
LGO.                      OR OTHER LOAD AND EXECUTE CARD(S)
```

FOR EXAMPLE,

```
JOBNAME.
CHARGE,....
FTN.
ATTACH,NSRDC.
LDSET,LIB=NSRDC.
LGO.
'   7/8/9     EOR
       PROGRAM TEST (INPUT=128, OUTPUT=128)
       ...
       CALL ANOVA1 (...)
       ...
       END
'   7/8/9     EOR
   (DATA CARDS)
"   6/7/8/9   EOF
```

INDIVIDUAL MACHINE-READABLE DOCUMENTS, WHEN AVAILABLE, MAY BE PRINTED (SEE PAGE 1-2).

## ARLNALG

THE AEROSPACE RESEARCH LABORATORIES (ARL) LINEAR ALGEBRA LIBRARY IS A COLLECTION OF 34 SUBROUTINES FOR SOLUTIONS TO LINEAR SYSTEMS AND DETERMINATION OF EIGENVALUES AND EIGENVECTORS OF REAL SYMMETRIC MATRICES. SOME OF THESE ROUTINES ARE SPECIFICALLY OPTIMIZED FOR THE CDC 6000 SERIES COMPUTERS.

REFERENCES: THE ARL LINEAR ALGEBRA LIBRARY HANDBOOK, NIKOLAI AND TSAO, AEROSPACE RESEARCH LABORATORIES, DAYTON, OHIO, JULY 1974, ARL TR 74-0106.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

ROUTINES IN LIBRARY 'ARLNALG' INCLUDE:

| | |
|---|---|
| BAC1 | EIGENVECTORS OF A SYMMETRIC MATRIX FROM THOSE OF ITS TRIDIAGONAL FORM |
| BAC2 | EIGENVECTORS OF A SYMMETRIC MATRIX FROM THOSE OF ITS TRIDIAGONAL FORM |
| BISEC | EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX BY THE BISECTION METHOD |
| FIP | FAST INNER PRODUCT EVALUATION OPTIMIZED FOR THE CDC 6000 |
| IMPR1 | ITERATIVE IMPROVEMENT TO MACHINE ACCURACY OF THE SOLUTION X OF AX = B OBTAINED USING SUBROUTINE LEQS1 |
| IMPR2 | ITERATIVE IMPROVEMENT TO MACHINE ACCURACY OF THE SOLUTION X OF AX = B OBTAINED USING SUBROUTINE LEQS2 |
| IMCL1 | EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC MATRIX |
| INIT | EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX BY INVERSE ITERATION |
| LEQS1 | SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU1 |
| LEQS2 | SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU2 |
| LEQS3 | SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU3 |
| LEQS4 | SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU4 |
| LEQS5 | SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU5 |
| LEQS6 | SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU6 |

| | |
|---|---|
| LU1 | LU FACTORIZATION OF A REAL SQUARE MATRIX |
| LU2 | LU FACTORIZATION OF A REAL SQUARE MATRIX BY THE CROUT METHOD WITH ACCUMULATING INNER PRODUCTS |
| LU3 | LU FACTORIZATION OF A REAL SQUARE MATRIX |
| LU4 | LU FACTORIZATION OF A REAL BAND MATRIX A TOGETHER WITH THE NUMBER OF POSITIVE EIGENVALUES IF A IS SYMMETRIC |
| LU5 | CHOLESKY FACTORIZATION OF A POSITIVE DEFINITE REAL SYMMETRIC MATRIX |
| LU6 | CHOLESKY FACTORIZATION OF A POSITIVE DEFINITE REAL SYMMETRIC BAND MATRIX |
| ORIMP | ITERATIVE IMPROVEMENT OF THE SOLUTION X OF AX = B OBTAINED USING SUBROUTINE ORSOL |
| ORSOL | LEAST SQUARES SOLUTION OF A LINEAR SYSTEM GIVEN AN ORTHOGONAL-TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY SUBROUTINE ORTHO |
| ORTHO | ORTHOGONAL TRANSFORMATION OF A GIVEN GENERAL M BY N MATRIX A TO UPPER TRIANGULAR FORM |
| ORTHO2 | ORTHOGONAL TRANSFORMATION OF A GENERAL M BY N MATRIX A TO UPPER TRIANGULAR FORM AND THE SOLUTION OF THE ASSOCIATED LINEAR LEAST SQUARES PROBLEM |
| QZABX | SOLUTION OF THE GENERALIZED MATRIX EIGENVALUE PROBLEM USING THE QZ ALGORITHM |
| REBAKA | RECOVERY OF EIGENVECTORS OF GENERALIZED SYMMETRIC EIGENVALUE PROBLEM FROM THOSE OF STANDARD FORM PRODUCED BY REDUC1 |
| REDUC1 | REDUCTION OF THE GENERALIZED SYMMETRIC EIGENVALUE PROBLEM TO STANDARD FORM |
| RITZIT | ITERATIVE COMPUTATION OF EIGENVALUES LARGEST IN MAGNITUDE AND CORRESPONDING EIGENVECTORS OF A REAL SYMMETRIC MATRIX |
| RNQL1 | EIGENVALUES OF A REAL SYMMETRIC TRIDIAGONAL MATRIX |
| SVD | SINGULAR VALUE DECOMPOSITION OF A REAL RECTANGULAR MATRIX |
| TRI1 | FAST HOUSEHOLDER TRIDIAGONAL FORM OF A REAL SYMMETRIC MATRIX |
| TRI2 | COMPACT HOUSEHOLDER TRIDIAGONAL FORM OF A REAL SYMMETRIC MATRIX |
| TRI3 | FAST HOUSEHOLDER TRIDIAGONAL FORM OF A REAL SYMMETRIC MATRIX FOR THE QL ALGORITHM |
| TRI4 | HOUSEHOLDER TRIDIAGONAL FORM OF A REAL SYMMETRIC MATRIX FOR THE QL ALGORITHM |

## EDSTAT (PROPRIETARY)

LIBRARY EDSTAT CONTAINS BOTH THE EDSTAT-P AND EDSTAT-V ROUTINES FOR STATISTICAL ANALYSIS OF BEHAVIORAL SCIENCE DATA WHICH WERE OBTAINED FROM DATA SCIENCES ASSOCIATES, AUSTIN, TEXAS.

SUBROUTINES IN LIBRARY 'EDSTAT' INCLUDE:

AEVS ROOTS AND VECTORS OF AN ASYMMETRIC MATRIX

ANOVAR GROUPS-BY-TRIALS ANALYSIS OF VARIANCE (WITH A SINGLE GROUP OR A SINGLE TRIAL, RESULTS ARE EQUIVALENT TO T-TESTS)

AVAR23 DOUBLE- OR TRIPLE-CLASSIFICATION FACTORIAL ANALYSIS OF VARIANCE, WITH PROVISION FOR UNEQUAL NUMBERS OF SCORES PER CELL

AVTRND ANALYSES OF VARIANCE (ONE FOR EACH DEPENDENT VARIABLE) FOR REPEATED MEASUREMENT DESIGNS HAVING RANDOMIZED OR FACTORIAL CLASSIFICATION OF SUBJECT GROUPS. TREND COMPONENTS (LINEAR, QUADRATIC, CUBIC AND QUARTIC) ARE ANALYZED. EQUAL NUMBER OF SUBJECTS PER GROUP IS REQUIRED.

AXBS MATRIX MULTIPLICATION

BETWEEN ANALYSES OF VARIANCE (ONE FOR EACH DEPENDENT VARIABLE) FOR MULTIPLE CLASSIFICATION FACTORIAL DESIGNS HAVING 1-6 LEVELS OF CLASSIFICATION

BETWITH ANALYSES OF VARIANCE (ONE FOR EACH DEPENDENT VARIABLE) FOR DESIGNS HAVING BOTH BETWEEN-SUBJECT DIMENSIONS AND WITHIN-SUBJECT DIMENSIONS. BETWEEN DIMENSIONS MAY BE RANDOMIZED GROUPS OR FACTORIALLY CLASSIFIED SUBJECT-GROUP DIMENSIONS. WITHIN DIMENSIONS MAY BE REPEATED MEASURES (TEST-RETEST OR TRIALS) OF 1-4 DIMENSIONS. BETWEEN-SUBJECT CELL FREQUENCIES NEED NOT BE EQUAL.

CANONA MULTIPLE CANONICAL CORRELATION ANALYSIS

CHICHI CHI-SQUARE ANALYSIS OF FREQUENCY DATA IN BIVARIATE TABLES, OR UNIVARIATE TESTS AGAINST HYPOTHESIZED EQUAL OR SPECIFIC DISTRIBUTIONS

CONTAB BIVARIATE FREQUENCY TABLES FOR ALL PAIRINGS OF A SERIES OF ONE-CHARACTER ALPHAMERIC VARIABLES, WITH PROVISION FOR SELECTING LESS THAN ALL POSSIBLE PAIRINGS

CORREL MEANS, STANDARD DEVIATIONS AND CORRELATIONS (MISSING DATA ALLOWED)

CORS MEANS, SIGMAS AND INTERCORRELATIONS

DISTAT DESCRIPTIVE STATISTICS, FREQUENCY DISTRIBUTIONS, AND STANDARD SCORE CONVERSIONS FOR A SERIES OF VARIABLES

DSCRIM MULTIPLE DISCRIMINANT ANALYSIS, INCLUDING UNIVARIATE COMPARISONS OF GROUPS

| | |
|---|---|
| FACTOR | INTERCORRELATION, PRINCIPAL-AXIS ANALYSIS, VARIMAX ROTATION, AND FACTOR-SCORE COMPUTATION, WITH PROVISIONS FOR MISSING DATA AND TRANSPOSED (SUBJECT PROFILE) ANALYSIS |
| FREQCY | FREQUENCY COUNTS |
| HGROUP | GENERALIZED DISTANCE ANALYSIS TO SUCCESSIVELY CLUSTER SUBJECTS OF VARIABLES (ALL STAGES OF REDUCTION FROM N ONE-PERSON GROUPS TO ONE N-PERSON GROUP ARE REPORTED) |
| ING | TRACING SUBROUTINE FOR EDSTAT DEBUGGING |
| INVS | MATRIX INVERSION |
| LAGCOR | AUTOCORRELATION AND CROSS-LAG CORRELATIONS;DETECTING CYCLIC FLUCTUATION IN A SERIES OF MEASURES OF ONE OR MORE VARIABLES |
| MDRS | MISSING-DATA INTERCORRELATION |
| PCDS | PUNCH OUTPUT OF AN ARRAY |
| PRBF | CHANCE PROBABILITY OF AN F-RATIO |
| PRTS | PRINT OUTPUT OF AN ARRAY |
| REGRAN | ITERATIVE MULTIPLE REGRESSION ANALYSIS, WITH PROVISION FOR MULTIPLE EQUATIONS, COMPARISON OF EQUATIONS BY F-TESTS, AND OUTPUT OF PREDICTED SCORES FOR SUBJECTS |
| RELATE | COMPARISON OF FACTOR STRUCTURES THROUGH REROTATION TO MAXIMIZE ITEM-VECTOR CONTIGUITY |
| RTMS | PUNCH OUTPUT OF A SYMMETRIC MATRIX |
| SCPF | SCALAR PRODUCT OF TWO VECTORS |
| SEVS | ROOTS AND VECTORS OF A SYMMETRIC MATRIX |
| SUBS | PUNCH OUTPUT OF A SCORE VECTOR |
| SUMF | SUMS AND SUMS OF SQUARES OF A VECTOR |
| TDPS | TRANSPOSED-DATA INTERCORRELATION |
| TESTAT | SCORING AND ITEM-ANALYSIS OF DATA FROM CHOICE-RESPONSE INSTRUMENTS, EITHER RIGHT-WRONG OR TIME-SUM SCALES |
| TSCALE | THRUSTONIAN SUCCESSIVE-INTERVALS SCALE CONSTRUCTION |
| TTESTS | MULTIPLE GROUPS ANALYSES OF VARIANCE AND SELECTED GROUPS T-TESTS (SCHEFFE METHOD) |
| VDRS | VARIMAX ROTATION OF A FACTOR STRUCTURE |
| WITHIN | ANALYSES OF VARIANCE (ONE FOR EACH DEPENDENT VARIABLE) FOR FACTORIAL DESIGNS IN WHICH EQUAL NUMBER OF SUBJECTS PER GROUP ARE MATCHED, OR FOR DESIGNS HAVING FACTORIALLY CLASSIFIED REPEATED MEASURES UPON ONE GROUP OF SUBJECTS |

## EISPACK

THE EIGENSYSTEM PACKAGE FROM ARGONNE NATIONAL LABORATORY IS A COLLECTION OF 35 SUBROUTINES TO SOLVE EIGENVECTOR AND EIGENVALUE PROBLEMS. ROUTINES IN THIS PACKAGE ARE OFTEN SUPERIOR IN SPEED AND ACCURACY TO SIMILAR ROUTINES IN OTHER PACKAGES.

REFERENCES: LECTURE NOTES IN COMPUTER SCIENCE, VOLUME 6, "MATRIX EIGENSYSTEM ROUTINES - EISPACK GUIDE", SMITH, ET AL, SPRINGER-VERLAG, BERLIN-HEIDELBERG-NEW YORK, 1974

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

ROUTINES IN LIBRARY 'EISPACK' INCLUDE:

| | |
|---|---|
| BAKVEC | BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY FIGI |
| BALANC | BALANCE A REAL GENERAL MATRIX |
| BALBAK | BACK TRANSFORM THE EIGENVECTORS OF THAT REAL MATRIX TRANSFORMED BY BALANC |
| BANDR | REDUCE A REAL SYMMETRIC BAND MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX USING AND OPTIONALLY ACCUMULATING ORTHOGONAL TRANSFORMATIONS |
| BANDV | DETERMINE SOME EIGENVECTORS OF A REAL SYMMETRIC BAND MATRIX OR SOLVE BAND EQUATIONS |
| BISECT | DETERMINE SOME EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX |
| BQR | DETERMINE SOME EIGENVALUES OF A REAL SYMMETRIC BAND MATRIX |
| CBABK2 | BACK TRANSFORM THE EIGENVECTORS OF THAT COMPLEX MATRIX TRANSFORMED BY CBAL |
| CBAL | BALANCE A COMPLEX GENERAL MATRIX |
| CG | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX GENERAL MATRIX |
| CH | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX HERMITIAN MATRIX |
| CINVIT | DETERMINE THOSE EIGENVECTORS OF A COMPLEX UPPER HESSENBERG MATRIX CORRESPONDING TO SPECIFIED EIGENVALUES |
| COMBAK | BACK TRANSFORM THE EIGENVECTORS OF THAT UPPER HESSENBERG MATRIX DETERMINED BY COMHES |
| COMHES | REDUCE A COMPLEX GENERAL MATRIX TO COMPLEX UPPER HESSENBERG FORM USING ELEMENTARY TRANSFORMATIONS |
| COMLR | DETERMINE THE EIGENVALUES OF A COMPLEX UPPER HESSENBERG MATRIX |

| | |
|---|---|
| COMLR2 | DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX UPPER HESSENBERG MATRIX |
| COMQR | DETERMINE THE EIGENVALUES OF A COMPLEX UPPER HESSENBERG MATRIX |
| COMQR2 | DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX HESSENBERG MATRIX |
| CORTB | BACK TRANSFORM THE EIGENVECTORS OF THAT UPPER HESSENBERG MATRIX DETERMINED BY CORTH |
| CORTH | REDUCE A COMPLEX GENERAL MATRIX TO UPPER HESSENBERG FORM USING UNITARY TRANSFORMATIONS |
| ELMBAK | BACK TRANSFORM THE EIGENVECTORS OF THAT UPPER HESSENBERG MATRIX DETERMINED BY ELMHES |
| ELMHES | REDUCE A REAL GENERAL MATRIX TO UPPER HESSENBERG FORM USING ELEMENTARY TRANSFORMATIONS |
| ELTRAN | ACCUMULATE THE TRANSFORMATIONS IN THE REDUCTION OF A REAL GENERAL MATRIX BY ELMHES |
| FIGI | TRANSFORM A CERTAIN REAL NON-SYMMETRIC TRIDIAGONAL MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX |
| FIGI2 | TRANSFORM A CERTAIN REAL NON-SYMMETRIC TRIDIAGONAL MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX ACCUMULATING THE DIAGONAL TRANSFORMATIONS |
| HQR | DETERMINE THE EIGENVALUES OF A REAL UPPER HESSENBERG MATRIX |
| HQR2 | DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL UPPER HESSENBERG MATRIX |
| HTRIBK | BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY HTRIDI |
| HTRIB3 | BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY HTRID3 |
| HTRIDI | REDUCE A COMPLEX HERMETIAN MATRIX TO A REAL SYMMETRIC TRIDIAGONAL MATRIX USING UNITARY TRANSFORMATIONS |
| HTRID3 | REDUCE A COMPLEX HERMETIAN MATRIX, STORED AS A SINGLE SQUARE ARRAY, TO A REAL SYMMETRIC TRIDIAGONAL MATRIX USING UNITARY TRANSFORMATIONS |
| IMTQLV | DETERMINE THE EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX |
| IMTQL1 | DETERMINE THE EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX |
| IMTQL2 | DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX |
| INVIT | DETERMINE THOSE EIGENVECTORS OF A REAL UPPER HESSENBERG MATRIX CORRESPONDING TO SPECIFIED EIGENVALUES |

| | |
|---|---|
| MINFIT | COMPUTE THE SINGLUAR VALUE DECOMPOSITION OF AN ARBITRARY REAL RECTANGULAR MATRIX AND THE SOLUTION OF A RELATED LINEAR LEAST SQUARES PROBLEM |
| ORTBAK | BACK TRANSFORM THE EIGENVECTORS OF THAT UPPER HESSENBERG MATRIX DETERMINED BY ORTHES |
| ORTHES | REDUCE A REAL GENERAL MATRIX TO UPPER HESSENBERG FORM USING ORTHOGONAL TRANSFORMATIONS |
| ORTRAN | ACCUMULATE THE TRANSFORMATIONS IN THE REDUCTION OF A REAL GENERAL MATRIX BY ORTHES |
| QZHES | SIMULTANEOUSLY REDUCE ONE OF A PAIR OF REAL GENERAL MATRICES TO UPPER HESSENBERG FORM AND THE OTHER TO UPPER TRIANGULAR FORM USING AND OPTIONALLY ACCUMULATING ORTHOGONAL TRANSFORMATIONS |
| QZIT | REDUCE ONE OF A PAIR OF REAL MATRICES FROM UPPER HESSENBERG TO QUASI-UPPER TRIANGULAR FORM WHILE MAINTAINING THE UPPER TRIANGULAR FORM OF THE OTHER USING AND OPTIONALLY ACCUMULATING ORTHOGONAL TRANSFORMATIONS |
| QZVAL | EXTRACT THE GENERALIZED EIGENVALUES OF A REAL MATRIX SYSTEM WITH ONE MATRIX IN QUASI-UPPER TRIANGULAR FORM AND THE OTHER IN UPPER TRIANGULAR FORM USING AND OPTIONALLY ACCUMULATING ORTHOGONAL TRANSFORMATIONS |
| QZVEC | DETERMINE THE GENERALIZED EIGENVECTORS OF A REAL MATRIX SYSTEM WITH ONE IN QUASI-UPPER TRIDIAGONAL FORM AND THE OTHER IN UPPER TRIANGULAR FORM USING BACK SUBSTITUTION |
| RATQR | DETERMINE SOME EXTREME EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX |
| REBAKB | BACK TRANSFORM THE EIGENVECTORS OF THAT DERIVED SYMMETRIC MATRIX DETERMINED BY REDUC2 |
| REBAK | BACK TRANSFORM THE EIGENVECTORS OF THAT DERIVED SYMMETRIC MATRIX DETERMINED BY REDUC OR REDUC2 |
| REDUC | REDUCE A CERTAIN GENERALIZED SYMMETRIC EIGENPROBLEM TO THE STANDARD SYMMETRIC EIGENPROBLEM USING CHOLSKY DECOMPOSITION |
| REDUC2 | REDUCE CERTAIN GENERALIZED SYMMETRIC EIGENPROBLEMS TO STANDARD SYMMETRIC EIGENPROBLEMS USING CHOLSKY DECOMPOSITION |
| RG | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL GENERAL MATRIX |
| RGG | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS FOR THE REAL GENERAL GENERALIZED EIGENPROBLEM A*X = (LAMBDA)*B*X |
| RS | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC MATRIX |

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|---|---|
| RSB | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC BAND MATRIX |
| RSG | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS FOR THE REAL SYMMETRIC GENERALIZED EIGENPROBLEM A*X = (LAMBDA)*B*X |
| RSGAB | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS FOR THE REAL SYMMETRIC GENERALIZED EIGENPROBLEM A*B*X = (LAMBDA)*X |
| RSGBA | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS FOR THE REAL SYMMETRIC GENERALIZED EIGENPROBLEM B*A*X = (LAMBDA)*X |
| RSP | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC PACKED MATRIX |
| RST | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC TRIDIAGONAL MATRIX |
| RT | DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A CERTAIN REAL TRIDIAGONAL MATRIX |
| SVD | COMPUTE THE SINGULAR VALUE DECOMPOSITION OF AN ARBITRARY REAL RECTANGULAR MATRIX |
| TINVIT | DETERMINE SOME EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX |
| TQLRAT | DETERMINE THE EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX |
| TQL1 | DETERMINE THE EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX |
| TQL2 | DETERMINE THE EIENVALUES AND EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX |
| TRBAK1 | BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY TRED1 |
| TRBAK3 | BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY TRED3 |
| TRED1 | REDUCE A REAL SYMMETRIC MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX USING ORTHOGONAL TRANSFORMATIONS |
| TRED2 | RETURN A REAL SYMMETRIC MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX ACCUMULATING THE ORTHOGONAL TRANSFORMATIONS |
| TRED3 | REDUCE A REAL SYMMETRIC MATRIX, STORED AS A ONE-DIMENSIONAL ARRAY, TO A SYMMETRIC TRIDIAGONAL MATRIX USING ORTHOGONAL TRIDIAGONAL MATRIX USING ORTHOGONAL TRANSFORMATIONS |
| TRIDIB | DETERMINE SOME EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX |
| TSTURM | DETERMINE SOME EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX |

## FUNPACK

SPECIAL FUNCTIONAL SUBROUTINE PACKAGE FROM ARGONNE NATIONAL LABORATORY CONTAINING 24 USER-CALLABLE ROUTINES FOR BESSEL FUNCTIONS, DAWSON'S INTEGRAL, ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND AND EXPONENTIAL INTEGRAL.

REFERENCES: MASTER DOCUMENTS ON FILE IN USER SERVICES.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

ROUTINES IN LIBRARY 'FUNPACK' INCLUDE:

| | |
|---|---|
| BESI0 | FUNCTION TO CALCULATE MODIFIED BESSEL FUNCTIONS OF THE FIRST KIND OF ORDER ZERO, I0(X) |
| BESEI0 | FUNCTION TO CALCULATE MODIFIED BESSEL FUNCTIONS OF THE FIRST KIND OF ORDER ZERO, EXP(-ABS(X))*I0(X) |
| BESI1 | FUNCTION TO CALCULATE MODIFIED BESSEL FUNCTIONS OF THE FIRST KIND OF ORDER ONE, I1(X) |
| BESEI1 | FUNCTION TO CALCULATE MODIFIED BESSEL FUNCTIONS OF THE FIRST KIND OF ORDER ONE, EXP(-ABS(X))*I1(X) |
| BESJ0 | FUNCTION TO CALCULATE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDER ZERO, J0(X) |
| BESJ1 | FUNCTION TO CALCULATE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDER ONE, J1(X) |
| BESK0 | COMPUTE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND OF ORDER ZERO, K0(X), FOR REAL, POSITIVE X |
| BESEK0 | COMPUTE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND OF ORDER ZERO, EXP(X)*K0(X), FOR REAL, POSITIVE X |
| BESK1 | COMPUTE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND OF ORDER ONE, K1(X), FOR REAL, POSITIVE X |
| BESEK1 | COMPUTE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND OF ORDER ONE, EXP(X)*K1(X), FOR REAL, POSITIVE X |
| BESY | SUBROUTINE TO COMPUTE BESSEL FUNCTIONS OF THE SECOND KIND OF NON-NEGATIVE ORDER, Y-SUB-NU(X), FOR REAL, POSITIVE X (SEE YNU) |
| DAW | FUNCTION TO COMPUTE DAWSON'S INTEGRAL FOR ALL REAL ARGUMENTS |

| | |
|---|---|
| ELIPE | COMPUTE COMPLETE COMPLETE ELLIPTIC INTEGRALS OF THE SECOND KIND, E(CAYSQ) |
| ELIE1 | COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE SECOND KIND, E(CAY**2) |
| ELIEM | COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE SECOND KIND, E(1-ETA) |
| ELIPK | COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND, K(CAYSQ) |
| ELIK1 | COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND, K(CAY**2) |
| ELIKM | COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND, K(1-ETA) |
| EI | COMPUTE EXPONENTIAL INTEGRAL, EI(X) |
| EONE | COMPUTE EXPONENTIAL INTEGRAL, E-SUB-1(X) |
| EXPEI | COMPUTE EXPONENTIAL INTEGRAL, EXP(-X)*EI(X) |
| MONERR | ERROR HANDLING FACILITIES, INCLUDING USER INTERACTION, FOR FUNPACK |
| PSI | FUNCTION TO COMPUTE LOGARITHMIC DERIVATIVE OF THE GAMMA FUNCTION FOR REAL ARGUMENTS |
| YNU | FUNCTION TO COMPUTE BESSEL FUNCTIONS OF THE SECOND KIND OF NON-NEGATIVE REAL ORDER, Y-SUB-NU(X), FOR REAL, POSITIVE X (SEE BESY) |

## IMSL (PROPRIETARY)

THE INTERNATIONAL MATHEMATICAL AND STATISTICAL LIBRARIES PACKAGE CONTAINS OVER 400 SUBROUTINES IN THE FOLLOWING AREAS:

- .ANALYSIS OF EXPERIMENTAL DESIGN DATA
- .RANDOM NUMBERS, GENERATION AND TESTING
- .STATISTICS, BASIC, NON-PARAMETIC, SPECIAL FUNCTIONS
- .REGRESSION ANALYSIS
- .DIFFERENTIAL EQUATIONS, INTERPOLATION, APPROXIMATION, SMOOTHING
- .LINEAR ALGEBRAIC EQUATIONS
- .VECTOR MATRIX ARITHMETIC

EDITION 6 OF IMSL CONTAINS ALL PREVIOUS UPDATES AND INCLUDES 39 NEW SUBROUTINES.

REFERENCES: THE IMSL LIBRARY, VOLUMES 1 AND 2.

SHORT MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

ROUTINES IN LIBRARY 'IMSL' INCLUDE:

| | |
|---|---|
| ABALAT | ANALYZE BALANCED LATTICE DESIGN DATA. (ENTRY IN ABIBAN) |
| ABIBAN | ANALYZE BALANCED INCOMPLETE BLOCK DESIGN DATA |
| ACRDAN | ANALYZE ONE-WAY CLASSIFICATION DESIGN DATA |
| ACTRST | COMPUTE CONTRAST ESTIMATES AND SUMS OF SQUARES |
| AFACAN | COMPUTE SUMS OF SQUARES AND DEGREES OF FREEDOM FOR ALL EFFECTS IN A FULL FACTORIAL PLAN |
| AFACMN | COMPUTE A COMPLETE SET OF MEANS FOR ALL EFFECTS IN A FULL FACTORIAL PLAN (ENTRY IN AFACAN) |
| AFACT | FULL FACTORIAL PLAN ANALYSIS - EASY TO USE VERSION |
| AGBACP | ANALYZE BALANCED COMPLETE STRUCTURE DESIGN DATA |
| AGLMOD | COMPUTE PARAMETER ESTIMATES, CORRESPONDING VARIANCE-COVARIANCE MATRIX ESTIMATE AND SUM OF SQUARES, FOR A GENERAL LINEAR MODEL |
| AGVACL | COMPUTE A ONE OR TWO-SIDED INTERVAL ESTIMATE OF A VARIANCE COMPONENT |
| AGXPMN | FIND EXPECTED MEAN SQUARE, DEGREES OF FREEDOM, TEST TERM AND ITS DEGREES OF FREEDOM FOR EACH MODEL TERM IN A BALANCED COMPLETE EXPERIMENTAL DESIGN STRUCTURE MODEL (ENTRY IN AGXPMS) |
| AGXPMS | FIND EXPECTED MEAN SQUARE, DEGREES OF FREEDOM, TEST TERM AND DEGREES OF FREEDOM, F-VALUE, AND VARIANCE COMPONENT ESTIMATE FOR EACH TERM IN ANY BALANCED COMPLETE EXPERIMENTAL DESIGN STRUCTURE MODEL |

| | |
|---|---|
| ALSCAN | ANALYZE LATIN SQUARE DESIGN DATA |
| AMEANS | PREPARE A SET OF UNBALANCED DATA FOR ANALYSIS BY THE METHOD OF UNWEIGHTED MEANS |
| ANCOV1 | COVARIANCE ANALYSIS FOR ONE-WAY CLASSIFICATION DESIGN DATA |
| ANESTE | ANALYZE COMPLETELY NESTED DESIGN DATA WITH EQUAL NUMBERS IN THE SUBCLASSES |
| ANESTU | ANALYZE COMPLETELY NESTED DESIGN DATA WITH UNEQUAL NUMBERS IN THE SUBCLASSES |
| AORDR | REORDERING OF THE DATA OBTAINED FROM ANY BALANCED COMPLETE EXPERIMENTAL DESIGN |
| ARCBAN | ANALYZE TWO-WAY CLASSIFICATION DESIGN DATA |
| ASNKMC | PERFORM STUDENT-NEWMAN-KEULS MULTIPLE COMPARISON TEST |
| BDCOU1 | TALLY OBSERVATIONS INTO A ONE-WAY FREQUENCY TABLE |
| BDCOU2 | TALLY OBSERVATIONS INTO A TWO-WAY FREQUENCY TABLE |
| BDTRGI | TRANSGENERATE THE COLUMNS OF A MATRIX - IN CORE VERSION |
| BDTRGO | TRANSGENERATE THE COLUMNS OF A MATRIX - OUT OF CORE VERSION |
| BECORI | CALCULATE MEANS, STANDARD DEVIATIONS, AND CORRELATION COEFFICIENTS - IN CORE VERSION |
| BECORO | CALCULATE MEANS, STANDARD DEVIATIONS, AND CORRELATION COEFFICIENTS - OUT OF CORE VERSION |
| BECOVM | CALCULATE MEANS AND VARIANCE-COVARIANCE MATRIX |
| BECTR | ESTIMATE RHO IN A BIVARIATE NORMAL POPULATION (TETRACHORIC CORRELATION COEFFICIENT) WITH GROUPED OBSERVATIONS |
| BECVLI | COMPUTE VARIANCES AND COVARIANCES OF LINEAR FUNCTIONS - IN CORE VERSION |
| BECVLO | COMPUTE VARIANCES AND COVARIANCES OF LINEAR FUNCTIONS - OUT OF CORE VERSION |
| BEGRPS | CALCULATE THE FIRST FOUR MOMENTS FOR GROUPED DATA ON EQUAL CLASS INTERVALS AND THE CORRESPONDING CORRECTED MOMENTS USING SHEPPARD'S CORRECTIONS |
| BEIGRP | ESTIMATE BASIC STATISTICAL PARAMETERS USING GROUPED DATA |
| BEIUGR | ESTIMATE BASIC STATISTICAL PARAMETERS USING UNGROUPED DATA |
| BELBIN | INTERVAL ESTIMATE OF THE PARAMETER P OF THE BINOMIAL DISTRIBUTION |

BELPOS INTERVAL ESTIMATE OF THE PARAMETER, LAMBDA, OF THE POISSON DISTRIBUTION

BEMTRY CALCULATE MEANS, SIMPLE REGRESSION COEFFICIENTS, THEIR INTERCEPTS, STANDARD ERRORS OF THE REGRESSION COEFFICIENTS, AND STANDARD DEVIATIONS FOR ARRAYS WHICH CONTAIN MISSING VALUES (IN CORE VERSION)

BEMTRO CALCULATE MEANS, SIMPLE REGRESSION COEFFICIENTS, THEIR INTERCEPTS, STANDARD ERRORS OF THE REGRESSION COEFFICIENTS, AND STANDARD DEVIATIONS FOR ARRAYS WHICH CONTAIN MISSING VALUES (OUT OF CORE VERSION)

BEMMI CALCULATE MEANS, CORRELATION COEFFICIENTS, STANDARD DEVIATIONS AND THIRD AND FOURTH MOMENTS FOR ARRAYS WHICH CONTAIN MISSING VALUES (IN CORE VERSION)

BEMMO CALCULATE MEANS, CORRELATION COEFFICIENTS, STANDARD DEVIATIONS AND THIRD AND FOURTH MOMENTS FOR ARRAYS WHICH CONTAIN MISSING VALUES (OUT OF CORE VERSION)

BEMNCN MAKE LOCATION (MEAN) INFERENCES USING A SAMPLE FROM A NORMAL POPULATION WITH KNOWN VARIANCE

BEMSCN MAKE MEAN AND VARIANCE INFERENCES USING A SAMPLE FROM A NORMAL POPULATION

BENSCN MAKE VARIANCE INFERENCES USING A SAMPLE FROM A NORMAL POPULATION WITH KNOWN MEAN

BEPATN MAKE MEAN AND VARIANCE INFERENCES USING SAMPLES FROM EACH OF TWO NORMAL POPULATIONS WITH UNEQUAL VARIANCES (ENTRY IN BEPATS)

BEPATS MAKE MEAN AND VARIANCE INFERENCES USING SAMPLES FROM EACH OF TWO NORMAL POPULATIONS WITH UNEQUAL VARIANCES, ALLOWING ANY LINEAR RELATIONSHIP BETWEEN THE POPULATION MEANS AND ANY MULTIPLICATIVE LINEAR RELATIONSHIP BETWEEN THE POPULATION VARIANCES

BEPETN MAKE MEAN AND VARIANCE INFERENCES USING SAMPLES FROM EACH OF TWO NORMAL POPULATIONS WITH EQUAL VARIANCES (ENTRY IN BEPETS)

BEPETS MAKE MEAN AND VARIANCE INFERENCES USING SAMPLES FROM EACH OF TWO NORMAL POPULATIONS WITH EQUAL VARIANCES, ALLOWING ANY LINEAR RELATIONSHIP BETWEEN THE POPULATION MEANS

BESRB COMPUTE A BISERIAL (AND POINT-BISERIAL) CORRELATION COEFFICIENT BETWEEN VARIABLES, ONE OF WHICH IS QUALITATIVELY (BINARY) DICHOTOMIZED, AND THE OTHER IS NUMERICALLY MEASURABLE AND CLASSIFIED

BESRN COMPUTE A BISERIAL CORRELATION COEFFICIENT BETWEEN VARIABLES, ONE OF WHICH IS QUALITATIVELY DICHOTOMIZED AND THE OTHER NUMERICALLY OR QUALITATIVELY CLASSIFIED, NOT NECESSARILY ORDERED

| | |
|---|---|
| CBNRHO | MAXIMUM LIKELIHOOD ESTIMATE OF THE CORRELATION COEFFICIENT USING A CONTINGENCY TABLE DERIVED FROM A BIVARIATE NORMAL POPULATION |
| CTBNLL | EVALUATE A QUANTITY PROPORTIONAL TO THE NATURAL LOGARITHM OF THE LIKELIHOOD OF A CONTINGENCY TABLE DERIVED FROM A BIVARIATE NORMAL POPULATION |
| CTRBYC | ANALYSIS OF CONTINGENCY TABLE |
| DASCRU | AUTOMATIC STEP CHANGE MERSON DIFFERENTIAL EQUATION SOLVER DX/DT=F(X,T), X(A)=X0 |
| DBCEVU | BICUBIC SPLINE MIXED PARTIAL DERIVATIVE EVALUATOR |
| DBCGDU | COMPUTE AN APPROXIMATE DOUBLE INTEGRAL TO A GIVEN TABLE OF DATA USING A NATURAL BICUBIC SPLINE INTERPOLANT |
| DCADRE | INTEGRATE F(X) FROM A TO B, USING CAUTIOUS ADAPTIVE ROMBERG EXTRAPOLATION |
| DCSEVU | EVALUATION OF FIRST AND SECOND DERIVATIVES OF A CUBIC SPLINE |
| DCSGDU | INTEGRATE A CUBIC SPLINE BETWEEN LIMITS A AND B |
| DREBS | FIRST ORDER DIFFERENTIAL EQUATION SOLVER - THE METHOD OF BULIRSCH - STOER FOR DY/DT = F(Y,T) |
| DVERK | SOLUTION OF A SYSTEM OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS OF THE FORM DY/DX = F(X,Y) WITH INITIAL CONDITIONS (A RUNGE-KUTTA METHOD BASED ON VERNER'S FIFTH AND SIXTH ORDER PAIR OF FORMULAS IS USED) |
| DVCGER | FIRST ORDER DIFFERENTIAL EQUATION SOLVER- GEAR'S METHOD FOR DX/DT=F(X,T) |
| EBALAC | BALANCES A COMPLEX GENERAL MATRIX AND ISOLATES EIGENVALUES WHENEVER POSSIBLE |
| EBALAF | BALANCE A REAL MATRIX A |
| EBBCKC | BACKTRANSFORM THE EIGENVECTORS OF A BALANCED COMPLEX GENERAL MATRIX |
| EBBCKF | BACKTRANSFORM EIGENVECTORS OF A BALANCED MATRIX |
| EHBCKF | BACKTRANSFORM THE EIGENVECTORS OF THE UPPER HESSENBERG MATRIX FOUND IN EHESSF |
| EHBCKH | BACKTRANSFORM THE EIGENVECTORS OF A REAL SYMMETRIC TRIDIAGONAL MATRIX OBTAINED FROM A HERMITIAN MATRIX |
| EHESSC | REDUCTION OF A COMPLEX MATRIX TO COMPLEX UPPER HESSENBERG FORM |

| | |
|---|---|
| EHESSF | REDUCE A NONSYMMETRIC MATRIX TO UPPER HESSENBERG FORM BY ORTHOGONAL TRANSFORMATIONS |
| EHORKS | PERFORM A BACK TRANSFORMATION TO FORM THE EIGENVECTORS OF THE ORIGINAL SYMMETRIC MATRIX FROM THE EIGENVECTORS OF THE TRIDIAGONAL MATRIX |
| EHOUSH | REDUCTION OF A COMPLEX HERMITIAN MATRIX TO A REAL SYMMETRIC TRIDIAGONAL MATRIX |
| EHOUSS | REDUCE A SYMMETRIC MATRIX A TO SYMMETRIC TRIDIAGONAL FORM USING HOUSEHOLDER'S REDUCTION |
| EIGCC | CALCULATE EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A COMPLEX GENERAL MATRIX |
| EIGCH | CALCULATE EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A COMPLEX HERMITIAN MATRIX |
| EIGRF | CALCULATE EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A REAL GENERAL MATRIX |
| EIGRS | CALCULATE EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A REAL SYMMETRIC MATRIX |
| EIGZC | CALCULATE EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A SYSTEM A*X=LAMBDA*B*X WHERE A AND B ARE COMPLEX MATRICES OF ORDER N |
| EIGZF | CALCULATE EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A SYSTEM A*X=LAMBDA*B*X WHERE A AND B ARE REAL MATRICES OF ORDER N |
| ELRH1C | COMPUTATION OF ALL EIGENVALUES OF A COMPLEX UPPER HESSENBERG MATRIX |
| ELRH2C | COMPUTE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX UPPER HESSENBERG MATRIX AND BACK TRANSFORM THE EIGENVECTORS |
| ELXHC | REDUCE TWO COMPLEX MATRICES, A AND B, SIMULTANEOUSLY, A TO UPPER HESSENBERG AND B TO UPPER TRIANGULAR FORM |
| ELZVC | CALCULATE THE EIGENVALUES AND, OPTIONALLY, EIGENVECTORS OF THE SYSTEM A*Z=LAMBDA*B*Z WHERE COMPLEX MATRIX A IS UPPER HESSENBERG AND COMPLEX MATRIX B IS UPPER TRIANGULAR |
| EQRH1F | FIND THOSE EIGENVECTORS OF A REAL UPPER HESSENBERG MATRIX CORRESPONDING TO SPECIFIED EIGENVALUES |
| EQRH3F | FIND THE EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A REAL UPPER HESSENBERG MATRIX |
| EQRT1S | COMPUTE THE SMALLEST EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX USING THE QR ALGORITHM |
| EQRT2S | FIND THE EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A TRIDIAGONAL MATRIX, T, USING THE QL METHOD |

EQRT3S GIVEN A TRIDIAGONAL MATRIX T, FIND M AND LAMDA(I),I=1,...,M WHERE M IS THE SMALLEST INTEGER SUCH THAT ABS(LAMDA(1))+...+ ABS(LAMDA(M)) IS GREATER THAN OR EQUAL TO THE ABS(VALUE) AND LAMDA(1),...,LAMDA(M) ARE THE SMALLEST M EIGENVALUES OF T AND <VALUE> AS SPECIFIED BY THE USER

EQZGF REDUCE TWO MATRICES, A AND B, SIMULTANEOUSLY, A TO UPPER HESSENBERG AND B TO UPPER TRIANGULAR FORM

EQZTF QZ ITERATION - REDUCE AN UPPER HESSENBERG MATRIX A TO QUASI-UPPER TRIANGULAR FORM WHILE KEEPING MATRIX B TRIANGULAR

EQZVF CALCULATE THE EIGENVALUES AND, OPTIONALLY, EIGENVECTORS OF THE SYSTEM A*Z=LAMBDA*B*Z WHERE A IS QUASI-UPPER TRIANGULAR AND B IS UPPER TRIANGULAR

FFCSIN COMPUTE THE SINE AND COSINE TRANSFORMS OF A SET OF REAL DATA

FFRQR2 THIS SUBROUTINE PERMUTES A COMPLEX DATA VECTOR IN REVERSE BINARY ORDER TO NORMAL ORDER. THE ROUTINE CAN ALSO BE USED TO PERMUTE A COMPLEX DATA VECTOR IN NORMAL ORDER TO REVERSE BINARY ORDER SINCE THE PERMUTATION IS SYMMETRIC.

FFTF COMPUTE THE FAST FOURIER TRANSFORM OF A DATA VECTOR

FFTR COMPUTE THE FAST FOURIER TRANSFORM OF A REAL DATA SEQUENCE

FFT2 COMPUTE THE FAST FOURIER TRANSFORM, GIVEN A COMPLEX VECTOR OF LENGTH EQUAL TO A POWER OF TWO

FFT2RV COMPUTE THE FAST FOURIER TRANSFORM, GIVEN A COMPLEX VECTOR OF LENGTH EQUAL TO A POWER OF TWO (DATA IN REVERSE BINARY ORDER)

FTARPS PRELIMINARY ESTIMATION OF THE AUTOREGRESSIVE PARAMETERS IN AN ARIMA STOCHASTIC MODEL

FTAUTO GIVEN A TIME SERIES COMPUTE 1. THE MEAN AND VARIANCE, 2. THE AUTOCOVARIANCES, 3. THE AUTOCOVARIANCES AND AUTOCORRELATIONS, 4. THE PARTIAL AUTOCORRELATIONS.

FTCAST USING A FITTED ARIMA STOCHASTIC MODEL, COMPUTE TIME SERIES FORECASTS AND PROBABILITY LIMITS FOR LEAD TIMES 1,2,3,...,LV(5)

FTCOMP NON-SEASONAL ARIMA STOCHASTIC MODEL ANALYSIS FOR A SINGLE TIME SERIES WITH FULL PARAMETER ITERATION AND MAXIMUM LIKELIHOOD ESTIMATION

FTCRCS GIVEN TWO MUTUALLY STATIONARY N CHANNEL TIME SERIES, COMPUTE A SELECTED SUBSET OF THE MEANS AND VARIANCES, CROSS-COVARIANCES, AND CROSS-CORRELATIONS

FTCRXY COMPUTE A SINGLE CROSS-COVARIANCE OF TWO MUTUALLY STATIONARY TIME SERIES

| | |
|---|---|
| FTFFT1 | FAST FOURIER TRANSFORM ESTIMATES OF POWER SPECTRA AND CROSS-SPECTRA OF TIME SERIES |
| FTFREQ | SINGLE OR MULTICHANNEL TIME SERIES ANALYSIS IN THE TIME AND FREQUENCY DOMAINS |
| FTFUNC | PROVIDE FUNCTIONAL COMMUNICATION BETWEEN FTMAPS AND ZSYSTM (NOT A STAND-ALONE ROUTINE) |
| FTGEN1 | GENERATE A TIME SERIES FOR A GIVEN ARIMA STOCHASTIC MODEL |
| FTKALM | KALMAN FILTERING |
| FTMAPS | PRELIMINARY ESTIMATION OF THE MOVING AVERAGE PARAMETERS IN AN ARIMA STOCHASTIC MODEL |
| FTMAXL | MAXIMUM LIKELIHOOD ESTIMATION OF AUTOREGRESSIVE AND MOVING AVERAGE PARAMETERS IN AN ARIMA STOCHASTIC MODEL |
| FTPDIF | TIME SERIES TRANSFORMATION AND DIFFERENCING |
| FTSIMP | NON-SEASONAL ARIMA STOCHASTIC MODEL ANALYSIS FOR A SINGLE TIME SERIES |
| FTTRAN | PRELIMINARY PARAMETER ESTIMATES FOR AN UNIVARIATE TRANSFER FUNCTION MODEL |
| FTWEIN | SINGLE CHANNEL WEINER FORECAST |
| FTWENM | COMPUTE THE LEAST SQUARES ESTIMATE OF MULTICHANNEL WEINER FILTER COEFFICIENTS |
| FTWENX | MAXIMUM LIKELIHOOD PARAMETER ESTIMATES FOR A MULTI-CHANNEL, SINGLE OUTPUT TIME SERIES MODEL |
| GFIT | CHI-SQUARED GOODNESS OF FIT TEST |
| GGAMA | GENERATE GAMMA (A,1) PSEUDO-RANDOM DEVIATES. THIS CODE CAN ALSO BE USED TO GENERATE EXPONENTIAL, CHI-SQUARED, CHI, BETA, T, AND F DEVIATES. |
| GGBIN | GENERATE ONE BINOMIAL PSEUDO RANDOM DEVIATE |
| GGBNB | GENERATE NEGATIVE BINOMIAL PSEUDO-RANDOM DEVIATES |
| GGBTA | GENERATE N DEVIATES DISTRIBUTED BETA(P,Q) (REJECTION METHOD) |
| GGCAU | GENERATE CAUCHY PSEUDO-RANDOM DEVIATES |
| GGCAU | GENERATE ONE CHI-SQUARED DEVIATE WITH N DEGREES OF FREEDOM |
| GGEOM | GENERATE GEOMETRIC PSEUDO-RANDOM DEVIATES |

GGEXP GENERATES EXPONENTIAL DEVIATES WITH MEAN XM AND STANDARD DEVIATION XM. THE DISTRIBUTION FUNCTION IS P=1-EXP(-X/XM). WHERE X IS GREATER THAN OR EQUAL TO ZERO. THIS ROUTINE USES UNIFORM (0,1) DEVIATES IN VECTOR R, GENERATED BY GGUB, AND TRANSFORMS USING -1 X = P (Y).

GGHYP GENERATE HYPERGEOMETRIC PSEUDO-RANDOM DEVIATES

GGMUL GENERATE ONE MULTINOMIAL PSEUDO-RANDOM DEVIATE

GGNLN GENERATE LOG NORMAL PSEUDO-RANDOM DEVIATES

GGNMP GENERATE NORMAL DEVIATES BY THE POLAR METHOD

GGNOF GENERATE ONE NORMAL (0,1) PSEUDO RANDOM NUMBER BY INVERTING THE NORMAL PROBABILITY DISTRIBUTION. GGUB (CODED INTERNALLY) PROVIDES THE UNIFORM PSEUDO RANDOM DEVIATE.

GGNOR GENERATE PSEUDO-NORMAL RANDOM NUMBERS

GGNRM MULTIVARIATE NORMAL DEVIATE GENERATOR. ENTRY GGNRM SHOULD BE USED ON THE FIRST CALL TO FACTOR THE SIGMA MATRIX AND GENERATE DEVIATES.

GGNRM1 MULTIVARIATE NORMAL DEVIATE GENERATOR. ENTRY GGNRM1 SHOULD BE USED ON ALL BUT THE FIRST CALL, IF MULTIPLE CALLS ARE NECESSARY. (ENTRY IN GGNRM)

GGPOSH GENERATE POISSON RANDOM DEVIATES

GGPOSR GENERATE POISSON RANDOM DEVIATES

GGSPR SAMPLE UNIFORMLY FROM THE SURFACE OF THE UNIT THREE OR FOUR SPHERE

GGTMAJ GENERATE GAMMA RANDOM DEVIATES (REJECTION METHOD)

GGTMA1 GENERATE N GAMMA (A,B) DEVIATES (ENTRY GGTMA1 SHOULD BE USED ON THE FIRST CALL FOR A GIVEN A AND B)

GGTMA2 GENERATE N GAMMA (A,B) DEVIATES (ENTRY GGTMA2 SHOULD BE USED ON ALL BUT THE FIRST CALL IF MULTIPLE CALLS ARE NECESSARY FOR THE SAME A AND B) (ENTRY IN GGTMA1)

GGTRI GENERATE TRIANGULAR PSEUDO-RANDOM DEVIATES

GGUB BASIC UNIFORM (0,1) PSEUDO-RANDOM NUMBER GENERATOR

GGUBF BASIC UNIFORM (0,1) PSEUDO-RANDOM NUMBER GENERATOR (FUNCTION FORM OF ROUTINE GGUB). GGUBF(ISEED) PROVIDES THE SAME DEVIATE AS DOES GGUB(ISEED,1,R). REFER TO THE DOCUMENT FOR GGUB FOR MORE DETAILED INFORMATION.

GGU4 GENERATE SHUFFLED UNIFORM (0,1) PSEUDO-RANDOM DEVIATES

| | |
|---|---|
| GGVACR | GENERATE IOP(2) RANDOM DEVIATES FROM THE DISTRIBUTION OF ANY CONTINUOUS RANDOM VARIABLE HAVING A STRICTLY MONOTONE INCREASING DISTRIBUTION FUNCTION (DF) |
| GGWEI | GENERATE WEIBULL PSEUDO-RANDOM DEVIATES |
| GTCN | DETERMINATION OF SAMPLE SIZE OR NUMBER OF CLASS INTERVALS |
| GTDD | D-SQUARE TALLY (ENTRY IN GTDD1) |
| GTDD1 | SAME AS GTDD, BUT MUST BE USED IN THE FIRST OF A SERIES OF CALLS TO GTDD |
| GTD2T | D-SQUARE TEST |
| GTMN | MOMENTS AND STANDARDIZED MOMENTS (ENTRY IN GTMN1 |
| GTMN1 | SAME AS GTMN, BUT MUST BE REFERENCED IN THE FIRST OF A SERIES OF CALLS TO GTMN |
| GTNOR | TEST FOR NORMALITY OF RANDOM DEVIATES |
| GTPBC | COUNTS THE NUMBER OF ZERO BITS IN A GIVEN WORD R |
| GTPKP | GENERATE A TABLE OF PROBABILITIES THAT, OF N ELEMENTS, EACH OF WHICH CAN TAKE ON TWO STATES, M ARE IN ONE STATE AND N-M ARE IN THE OTHER STATE. M RANGES THROUGH THE VALUES 0,1,...,K, WHERE K=N-M IF N IS EVEN AND N-M-1 OTHERWISE. GTPKP IS USED TO PREPARE EXPECTED VALUES FOR THE POKER TEST. |
| GTPL | POKER TEST TALLY OF HAND TYPES AND STATISTICS |
| GTPOK | POKER TEST |
| GTPRT | TALLY OF COORDINATES (R(I), R(I+1)) OF RANDOM NUMBERS |
| GTPST | PAIRS OF GOOD'S SERIAL TEST |
| GTRN | RUNS TEST |
| GTRT | TALLY OF NUMBER OF RUNS. IF THE SEQUENCE OF NUMBERS FITS INTO CORE ONLY THIS ENTRY IS USED. (ENTRY IN GTRTM) |
| GTRTM | TALLY OF NUMBER OF RUNS. THIS ENTRY USED WITH GTRT IF SEQUENCE OF RANDOM NUMBERS DOES NOT FIT IN CORE. |
| GTSRT | TALLY OF COORDINATES (R(I),R(I+L)) OF RANDOM NUMBERS (ENTRY IN GTPRT) |
| GTTRT | TALLY OF TRIPLETS |
| GTTT | TRIPLETS TEST |
| IBCEVU | EVALUATION OF A BICUBIC SPLINE |
| IBCICU | BICUBIC SPLINE TWO-DIMENSIONAL COEFFICIENT CALCULATOR |

IBCIEU BICUBIC SPLINE TWO-DIMENSIONAL INTERPOLATOR

ICSEVU EVALUATION OF A CUBIC SPLINE

ICSFKU LEAST SQUARES APPROXIMATION BY CUBIC SPLINES - FIXED KNOTS

ICSICU INTERPOLATORY APPROXIMATION BY CUBIC SPLINES WITH ARBITRARY SECOND DERIVATIVE END CONDITIONS

ICSMOU ONE-DIMENSIONAL DATA SMOOTHING BY ERROR DETECTION

ICSSCU CUBIC SPLINE DATA SMOOTHING

ICSVKU LEAST SQUARES APPROXIMATION BY CUBIC SPLINES - VARIABLE KNOTS

IQHSCU ONE-DIMENSIONAL QUASI-CUBIC HERMITE INTERPOLATION

IRATCU RATIONAL WEIGHTED CHEBYSHEV APPROXIMATION OF A CONTINUOUS FUNCTION

LEGT1B MATRIX DECOMPOSITION, LINEAR EQUATION SOLUTION - SPACE ECONOMIZER SOLUTION - BAND STORAGE MODE

LEGT1C MATRIX DECOMPOSITION, LINEAR EQUATION SOLUTION - SPACE ECONOMIZER SOLUTION - COMPLEX MATRICES

LEGT1F LINEAR EQUATION SOLUTION - FULL STORAGE MODE - SPACE ECONOMIZER SOLUTION

LEGT1P LINEAR EQUATION SOLUTION - SYMMETRIC STORAGE MODE - SPACE ECONOMIZER SOLUTION

LEGT2B MATRIX DECOMPOSITION, LINEAR EQUATION SOLUTION - HIGH ACCURACY SOLUTION - BAND STORAGE MODE

LEGT2C MATRIX DECOMPOSITION, LINEAR EQUATION SOLUTION - HIGH ACCURACY SOLUTION - COMPLEX MATRICES

LEGT2F LINEAR EQUATION SOLUTION - FULL STORAGE MODE - HIGH ACCURACY SOLUTION

LEGT2P LINEAR EQUATIONS SOLUTION - SYMMETRIC STORAGE MODE - HIGH ACCURACY SOLUTION

LEQ1PB LINEAR EQUATION SOLVER - SYMMETRIC BAND STORAGE MODE - SPACE ECONOMIZER SOLUTION

LEQ1S MATRIX DECOMPOSITION, LINEAR EQUATION SOLUTION - SPACE ECONOMIZER SOLUTION - SYMMETRIC STORAGE MODE - INDEFINITE MATRICES

LEQ2PB LINEAR EQUATION SOLUTION - SYMMETRIC BAND STORAGE MODE - HIGH ACCURACY SOLUTION

LEQ2S MATRIX DECOMPOSITION, LINEAR EQUATION SOLUTION - HIGH ACCURACY SOLUTION - SYMMETRIC STORAGE MODE - INDEFINITE MATRICES

| | |
|---|---|
| LINV1F | INVERSION OF A MATRIX - FULL STORAGE MODE - SPACE ECONOMIZER SOLUTION |
| LINV1P | INVERSION OF A POSITIVE DEFINITE SYMMETRIC MATRIX - SYMMETRIC STORAGE MODE - SPACE ECONOMIZER SOLUTION |
| LINV2F | INVERSION OF A MATRIX - FULL STORAGE MODE - HIGH ACCURACY SOLUTION |
| LINV2P | INVERSION OF MATRIX - SYMMETRIC STORAGE MODE- HIGH ACCURACY SOLUTION |
| LINV3F | MATRIX DECOMPOSITION, MATRIX INVERSION, LINEAR EQUATION SOLUTION, AND DETERMINANT EVALUATION |
| LINV3P | IN-PLACE MATRIX INVERSION AND LINEAR EQUATION SOLUTION - POSITIVE DEFINITE MATRIX - SYMMETRIC STORAGE MODE |
| LIN1PB | INVERSION OF A MATRIX - SYMMETRIC BAND STORAGE MODE - SPACE ECONOMIZER SOLUTION |
| LIN2PB | INVERSION OF A MATRIX - SYMMETRIC BAND STORAGE MODE - HIGH ACCURACY SOLUTION |
| LLSQAR | LEAST SQUARES SOLUTION OF OVERDETERMINED SYSTEM OF LINEAR EQUATIONS |
| LPSDOR | PSEUDO-INVERSE OF A MATRIX |
| LSVALR | SINGULAR VALUE DECOMPOSITION OF A MATRIX |
| LUDAPB | LU DECOMPOSITION OF A POSITIVE DEFINITE SYMMETRIC BAND MATRIX - CHOLESKY DECOMPOSITION |
| LUDATF | LU DECOMPOSITION BY THE CROUT ALGORITHM WITH OPTIONAL ACCURACY TEST |
| LUDECP | CHOLESKY DECOMPOSITION OF A MATRIX - SYMMETRIC STORAGE MODE |
| LUELMF | ELIMINATION PART OF SOLUTION OF AX=B - FULL STORAGE MODE |
| LUELMP | ELIMINATION PART OF THE SOLUTION OF AX=B - SYMMETRIC STORAGE MODE |
| LUELPB | ELIMINATION PORTION OF THE SOLUTION OF AX = B SYMMETRIC BAND STORAGE MODE |
| LUREFF | REFINEMENT OF SOLUTION TO LINEAR EQUATIONS - FULL STORAGE MODE |
| LUREFP | REFINEMENT OF SOLUTION TO LINEAR EQUATIONS - SYMMETRIC STORAGE MODE |
| LUREPB | REFINEMENT OF SOLUTION TO LINEAR EQUATIONS - SYMMETRIC BAND STORAGE MODE |
| MDBETA | INCOMPLETE BETA PROBABILITY DISTRIBUTION FUNCTION |

| | |
|---|---|
| MDBFTI | INVERSE INCOMPLETE BETA PROBABILITY DISTRIBUTION FUNCTION |
| MDBIN | BINOMIAL PROBABILITY DISTRIBUTION FUNCTION |
| MDBNOR | BIVARIATE NORMAL PROBABILITY DISTRIBUTION FUNCTION |
| MDCH | CHI-SQUARED PROBABILITY - NON-INTEGER DEGREES OF FREEDOM |
| MDCHI | INVERSE CHI-SQUARED PROBABILITY DISTRIBUTION FUNCTION |
| MDFD | F PROBABILITY DISTRIBUTION FUNCTION |
| MDFDRE | F PROBABILITY DISTRIBUTION FUNCTION |
| MDFI | INVERSE F PROBABILITY DISTRIBUTION FUNCTION |
| MDGAM | INCOMPLETE GAMMA PROBABILITY DISTRIBUTION FUNCTION |
| MDHYP | HYPERGEOMETRIC PROBABILITY DISTRIBUTION |
| MDNOR | EVALUATE THE NORMAL (0,1) PROBABILITY DISTRIBUTION FUNCTION (ENTRY IN MERF) |
| MDPOS | CUMULATIVE PROBABILITY FROM THE POISSON DISTRIBUTION FUNCTION (ENTRY IN MDTPOS) |
| MDSMR | KOLMOGOROV-SMIRNOV STATISTICS ASYMPTOTIC DISTRIBUTION FUNCTION VALUES |
| MDSTI | INVERT A MODIFICATION OF THE STUDENTS T DISTRIBUTION |
| MDTD | STUDENT'S T DISTRIBUTION |
| MDTN | NON-CENTRAL T PROBABILITY DISTRIBUTION FUNCTION |
| MDTNF | INTEGRATE T(Y,Z) FOR NON-CENTRAL T USAGE |
| MDTPOS | CUMULATIVE AND INDIVIDUAL TERMS OF THE POISSON PROBABILITY DISTRIBUTION FUNCTION |
| MERF | COMPUTE THE ERROR FUNCTION |
| MERFC | COMPUTE THE COMPLEMENTED ERROR FUNCTION (ENTRY IN MERF) |
| MERFCI | COMPUTE THE INVERSE COMPLEMENTED ERROR FUNCTION (ENTRY IN MERFI) |
| MERFI | COMPUTE THE INVERSE ERROR FUNCTION |
| MGAMMA | GAMMA FUNCTION OF A REAL ARGUMENT X |
| MLGAMA | NATURAL LOG OF THE GAMMA FUNCTION OF A REAL ARGUMENT X (ENTRY IN MGAMMA) |
| MMBSI0 | COMPUTE SINGLE PRECISION VALUES OF THE MODIFIED BESSEL FUNCTION OF THE FIRST KIND OF ORDER ZERO |

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| MMBSI1 | COMPUTE SINGLE PRECISION VALUES OF THE MODIFIED BESSEL FUNCTION OF THE FIRST KIND OF ORDER ONE |
| MMBSJ0 | COMPUTE SINGLE PRECISION VALUES OF THE BESSEL FUNCTION OF THE FIRST KIND OF ORDER ZERO |
| MMBSJ1 | COMPUTE SINGLE PRECISION VALUES OF THE BESSEL FUNCTION OF THE FIRST KIND OF ORDER ONE |
| MMBSK0 | COMPUTE SINGLE PRECISION VALUES OF THE MODIFIED BESSEL FUNCTION OF THE SECOND KIND OF ORDER ZERO |
| MMBSK1 | COMPUTE SINGLE PRECISION VALUES OF THE MODIFIED BESSEL FUNCTION OF THE SECOND KIND OF ORDER ONE |
| MMBSYN | COMPUTE SINGLE PRECISION VALUES OF THE BESSEL FUNCTION OF THE SECOND KIND OF NON-NEGATIVE REAL FRACTIONAL ORDER FOR REAL POSITIVE ARGUMENTS |
| MMDAW | COMPUTES SINGLE PRECISION VALUES OF DAWSON'S INTEGRAL |
| MMDEI | COMPUTE SINGLE PRECISION VALUES OF THE EXPONENTIAL INTEGRALS |
| MMDELE | COMPUTE SINGLE PRECISION VALUES OF THE COMPLETE ELLIPTIC INTEGRALS OF THE SECOND KIND |
| MMDELK | COMPUTE SINGLE PRECISION VALUES OF THE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND |
| MMKELD | EVALUATE THE DERIVATIVES OF THE KELVIN FUNCTIONS (BER,BEI,KER AND KEI) OF ORDER ZERO |
| MMKEL0 | EVALUATE THE KELVIN FUNCTIONS BER, BEI, KER AND KEI OF ORDER ZERO |
| MMKEL1 | EVALUATE THE KELVIN FUNCTIONS BER, BEI, KER AND KEI OF ORDER ONE |
| MDNRIS | COMPUTE THE INVERSE GAUSSIAN INTEGRAL |
| MSMRAT | COMPUTE Z(X)/Q(X), THE RATIO OF THE ORDINATE TO THE UPPER TAIL AREA OF THE STANDARDIZED NORMAL DISTRIBUTION, AT X |
| NAK1 | KRUSKAL-WALLIS TEST FOR IDENTICAL POPULATIONS |
| NAWNRP | WILSON ANALYSIS OF VARIANCE - NO REPLICATION |
| NAWRPE | WILSON ANALYSIS OF VARIANCE - EQUAL REPLICATION |
| NAWRPU | WILSON ANALYSIS OF VARIANCE - UNEQUAL REPLICATION |
| NBCYC | NOETHER'S TEST FOR CYCLICAL TREND |
| NBQT | PERFORM THE COCHRAN Q TEST |
| NBSD | COX AND STUART'S SIGN TEST FOR TRENDS IN DISPERSION |

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|---|---|
| NBSL | COX AND STUART'S SIGN TEST FOR TRENDS IN LOCATION (ENTRY IN NBSD) |
| NBSIGN | SIGN TEST |
| NDMPLE | ESTIMATE THE PROBABILITY DENSITY FUNCTION (PDF) WHICH GAVE RISE TO A RANDOM SAMPLE ACCORDING TO A DISCRETE NONPARAMETRIC MAXIMUM PENALIZED LIKELIHOOD CRITERION |
| NDXEST | EVALUATE THE PROBABILITY ESTIMATE FROM IMSL ROUTINE NDMPLE AT A POINT Y |
| NHFXT | FISHER'S EXACT METHOD FOR 2 BY 2 MATRICES |
| NHINC | INCLUDANCE TEST |
| NKS1 | KOLMOGOROV-SMIRNOV ONE-SAMPLE TEST |
| NKS2 | KOLMOGOROV-SMIRNOV TWO-SAMPLE TEST |
| NMCC | CALCULATE AND TEST THE SIGNIFICANCE OF THE KENDALL COEFFICIENT OF CONCORDANCE |
| NMKEN | KENDALL'S TEST FOR CORRELATION |
| NMKSF | GIVEN K, THE SCORE FROM THE KENDALL RANK CORRELATION COEFFICIENT CALCULATIONS (SEE NMKEN), AND N, THE SAMPLE SIZE, CALCULATE THE FREQUENCY DISTRIBUTION OF K AND THE PROBABILITY OF EQUALLING OR EXCEEDING THE GIVEN K |
| NMKST | JONCKHEERE'S K-SAMPLE TRENDS TEST AGAINST ORDERED ALTERNATIVES |
| NMRANK | NUMERICAL RANKING |
| NMTIE | GIVEN A MONOTONICALLY ORDERED SET OF OBSERVATIONS, DETERMINE TIES AND CERTAIN STATISTICS RELATED TO THE TIES. IN THE OUTPUT DESCRIPTION BELOW, T REFERS TO THE NUMBER OF OBSERVATIONS TIED FOR A GIVEN RANK, AND THE SUM IS OVER ALL RANKS. |
| NRPHA | BHAPKAR V TEST |
| NRWMP | WILCOXON'S SIGNED RANK TEST. IF THE DIFFERENCE, X-Y, HAS ALREADY BEEN COMPUTED INTO X, CALL NRWMPD. |
| NRWRST | WILCOXON'S RANK-SUM TEST |
| OCLINK | PERFORM A SINGLE-LINKAGE OR COMPLETE-LINKAGE HIERARCHICAL CLUSTER ANALYSIS GIVEN A SIMILARITY MATRIX |
| OFCOEF | COMPUTE A MATRIX OF FACTOR SCORE COEFFICIENTS FOR INPUT TO IMSL ROUTINE OFSCOR |
| OFCOMM | COMPUTE AN UNROTATED FACTOR LOADING MATRIX ACCORDING TO A COMMON FACTOR MODEL BY UNWEIGHTED OR GENERALIZED LEAST SQUARES, OR BY MAXIMUM LIKELIHOOD PROCEDURES |

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|---|---|
| OFHARR | TRANSFORMATION OF UNROTATED FACTOR LOADING MATRIX TO OBLIQUE AXES BY HARRIS-KAISER METHOD |
| OFIMAG | COMPUTE AN UNROTATED FACTOR LOADING MATRIX ACCORDING TO AN IMAGE MODEL |
| OFIMA3 | LEAST SQUARES SOLUTION TO THE MATRIX EQUATION AT = B |
| OFPRIN | COMPUTE AN UNROTATED FACTOR LOADING MATRIX ACCORDING TO A PRINCIPAL COMPONENT MODEL |
| OFPROT | OBLIQUE TRANSFORMATION OF THE FACTOR LOADING MATRIX USING A TARGET MATRIX, INCLUDING PIVOT AND POWER VECTOR OPTIONS |
| OFPSI | COMMUNALITIES AND NORMALIZED FACTOR RESIDUAL CORRELATION MATRIX CALCULATION |
| OFROTA | ORTHOGONAL ROTATION OF A FACTOR LOADING MATRIX USING A GENERALIZED ORTHOMAX CRITERION, INCLUDING QUARTIMAX, VARIMAX, AND EQUAMAX |
| OFSCHN | ORTHOGONAL TRANSFORMATION OF THE FACTOR LOADING MATRIX USING A TARGET MATRIX |
| OFSCOR | COMPUTE A SET OF FACTOR SCORES GIVEN THE FACTOR SCORE COEFFICIENT MATRIX |
| OIND | WILK'S TEST FOR THE INDEPENDENCE OF K SETS OF MULTI-NORMAL VARIATES |
| OPPINC | OBTAIN THE PRINCIPAL COMPONENTS OF AN M VARIATE SAMPLE OF OBSERVATIONS |
| OTMLNR | MAXIMUM LIKELIHOOD ESTIMATION FROM GROUPED AND CENSORED NORMAL DATA |
| RLCOMP | GENERATE THE INDEPENDENT VARIABLE SETTINGS FOR AN ORTHOGONAL CENTRAL COMPOSITE DESIGN, GIVEN THE MINIMUM AND MAXIMUM VALUE FOR EACH VARIABLE |
| RLDCQM | DECODE A QUADRATIC REGRESSION MODEL |
| RLDCVA | COMPUTE VARIANCES OF DECODED ORTHOGONAL POLYNOMIAL REGRESSION COEFFICIENTS |
| RLDCW | VARIANCES OF CODED ORTHOGONAL POLYNOMIAL REGRESSION COEFFICIENTS FOR USAGE ONLY IN CONJUNCTION WITH IMSL ROUTINES RLFOTH AND RLFOTW, AND PROVIDED TO PREPARE INPUT FOR IMSL ROUTINE RLOCVA |
| RLDOPM | DECODE AN ORTHOGONAL POLYNOMIAL REGRESSION MODEL |
| RLEAP | USING A LEAPS AND BOUNDS ALGORITHM, DETERMINE A NUMBER OF BEST REGRESSION SUBSETS OF A FULL REGRESSION MODEL |
| RLFITI | PURE REPLICATION ERROR DEGREES OF FREEDOM AND SUM OF SQUARES - IN CORE VERSION |

RLFITO PURE REPLICATION ERROR DEGREES OF FREEDOM AND SUM OF SQUARES - OUT OF CORE VERSION

RLFOR ORTHOGONAL POLYNOMIAL REGRESSION ANALYSIS - EASY TO USE VERSION

RLFORC SELECT REGRESSION MODEL USING FORWARD STEPWISE ALGORITHM (FORCING VARIABLES INTO THE MODEL) (ENTRY IN RLSTEP)

RLFOTH ORTHOGONAL POLYNOMIAL REGRESSION - FORSYTHE

RLFOTW WEIGHTED ORTHOGONAL POLYNOMIAL REGRESSION (FORSYTHE)

RLGGMI CENTER INDEPENDENT VARIABLE SETTINGS AND GENERATE CENTERED SQUARE AND CROSS PRODUCT TERMS - IN CORE VERSION

RLGGMO CENTER INDEPENDENT VARIABLE SETTINGS AND GENERATE UNCENTERED SQUARE AND CROSS PRODUCT TERMS - OUT OF CORE VERSION

RLINCE ONE OR TWO-SIDED RESPONSE CONTROL USING A FITTED SIMPLE LINEAR REGRESSION MODEL

RLINFE POINT AND INTERVAL INVERSE PREDICTION USING A FITTED SIMPLE LINEAR REGRESSION MODEL

RLMUL MULTIPLE LINEAR REGRESSION ANALYSIS

RLONE ANALYSIS OF A SIMPLE LINEAR REGRESSION MODEL

RLOPDC PREDICT RESPONSE USING ORTHOGONAL POLYNOMIAL REGRESSION MODEL

RLPOLY GENERATE ORTHOGONAL POLYNOMIALS

RLPOL1 GENERATE ORTHOGONAL POLYNOMIALS WITH THE ASSOCIATED CONSTANTS AA AND BB (ENTRY IN RLPOLY)

PLPRDI CALCULATE 100(1-ALPHA) PER CENT CONFIDENCE INTERVALS FOR THE TRUE RESPONSE AND FOR THE AVERAGE OF NR FUTURE OBSERVATIONS ON THE RESPONSE AT A SET OF N POINTS IN THE DESIGN SPACE - IN CORE VERSION

RLPRDO CALCULATE 100(1-ALPHA) PER CENT CONFIDENCE INTERVALS FOR THE TRUE RESPONSE, AND FOR THE AVERAGE OF NR FUTURE OBSERVATIONS ON THE RESPONSE, AT A POINT IN THE DESIGN SPACE - OUT OF CORE VERSION

RLRES PERFORM A RESIDUAL ANALYSIS FOR A FITTED REGRESSION MODEL ALLOWING, OPTIONALLY, A MODEL BASED ON A SUBSET OF THE ORIGINAL DATA MATRIX

RLSEP SELECTION OF A REGRESSION MODEL USING A FORWARD STEPWISE ALGORITHM AND COMPUTATION OF THE USUAL ANALYSIS OF VARIANCE TABLE ENTRIES - EASY TO USE VERSION

RLSTEP SELECT REGRESSION MODEL USING FORWARD STEPWISE ALGORITHM

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|---|---|
| RLSUBM | RETRIEVE A SYMMETRIC SUBMATRIX FROM A MATRIX STORED IN SYMMETRIC STORAGE MODE. RLSUBM MAY BE USED IN CONJUNCTION WITH RLSTEP. |
| RLSUM | REORDER ROWS AND CORRESPONDING COLUMNS OF A SYMMETRIC MATRIX STORED IN SYMMETRIC STORAGE MODE |
| RSMITZ | FIT THE NON-LINEAR REGRESSION MODEL Y(I) = ALPHA + BETA*GAMMA**X(I) + E(I) |
| RSMSSE | COMPUTE THE ERROR SUM OF SQUARES FOR THE MODEL Y(I) = ALPHA + BETA*GAMMA**X(I) + E(I) FOR GIVEN VALUES OF THE PARAMETERS, ALPHA, BETA, AND GAMMA |
| SSPAND | SIMPLE RANDOM SAMPLING WITH PROPORTION DATA-INFERENCES REGARDING THE POPULATION PROPORTION AND TOTAL |
| SSPBLK | STRATIFIED RANDOM SAMPLING WITH PROPORTION DATA - INFERENCES REGARDING THE POPULATION PROPORTION AND TOTAL |
| SSRAND | FOR THE CASE OF SIMPLE RANDOM SAMPLING WITH CONTINUOUS DATA, MAKE INFERENCES REGARDING THE POPULATION MEAN AND TOTAL USING RATIO OR REGRESSION ESTIMATION |
| SSRBLK | STRATIFIED RANDOM SAMPLING WITH CONTINUOUS DATA-INFERENCES REGARDING THE POPULATION MEAN AND TOTAL USING RATIO OR REGRESSION ESTIMATION |
| SSSAND | FOR THE CASE OF SIMPLE RANDOM SAMPLING WITH CONTINUOUS DATA MAKE INFERENCES REGARDING THE POPULATION MEAN AND TOTAL |
| SSSBLK | STRATIFIED RANDOM SAMPLING WITH CONTINUOUS DATA - INFERENCES REGARDING THE POPULATION MEAN AND TOTAL |
| SSSCAN | SINGLE STAGE CLUSTER SAMPLING WITH CONTINUOUS DATA - INFERENCES REGARDING THE POPULATION MEAN AND TOTAL |
| SSSEST | TWO-STAGE SAMPLING WITH CONTINUOUS DATA AND EQUISIZED PRIMARY UNITS - INFERENCES REGARDING THE POPULATION MEAN AND TOTAL |
| UERTST | ERROR MESSAGE GENERATION |
| USCROM | READ A MATRIX - OPTIONAL SEQUENCE CHECK |
| USHIST | PRINT A HISTOGRAM |
| USHIUT | PRINT A HISTOGRAM, ALLOWING PRINTING OF TWO FREQUENCIES USING ONE HISTOGRAM BAR |
| USHV1 | PRINT A HISTOGRAM (HORIZONTAL) |
| USLEAP | PRINT RESULTS OF THE BEST REGRESSIONS ANALYSIS PERFORMED BY IMSL ROUTINE PLEAP |
| USMNMX | LOCATES THE MINIMUM AND MAXIMUM VALUES OF A VECTOR |

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|---|---|
| USPC | PRINT SAMPLE PDF, THEORETICAL PDF AND CONFIDENCE BAND INFORMATION (PLOT THESE ON OPTION) |
| USPDF | PLOTS TWO SAMPLE PROBABILITY DISTRIBUTION FUNCTIONS AGAINST THEIR SPECTRA |
| USPLH | PROVIDES A PRINTER PLOT OF UP TO TEN FUNCTIONS |
| USRDM | READ A MATRIX |
| USRDV | READ A VECTOR |
| USRDVM | READ A VECTOR CONTAINING MISSING VALUE CODES |
| USTREE | PRINT A BINARY TREE (WHICH MAY REPRESENT THE RESULTS OF A HIERARCHICAL CLUSTERING ALGORITHM) |
| USWB | PRINT A MATRIX WITH OR WITHOUT USER-SUPPLIED COLUMN LABELS - BAND STORAGE MODE |
| USWBSM | PRINT A MATRIX WITH OR WITHOUT USER-SUPPLIED LABELS - BAND SYMMETRIC STORAGE MODE |
| USWLFM | PRINT A MATRIX WITH USER-SUPPLIED COLUMN LABELS - FULL STORAGE MODE |
| USWLSM | PRINT A MATRIX WITH USER-SUPPLIED LABELS - SYMMETRIC STORAGE MODE |
| USWTFM | PRINT A MATRIX - FULL STORAGE MODE |
| USWTFV | PRINT A VECTOR |
| USWTSM | PRINT A MATRIX - SYMMETRIC STORAGE MODE |
| USWTSV | PRINT ROW OR COLUMN OF A MATRIX - SYMMETRIC STORAGE MODE |
| VABMXF | FIND THE MAXIMUM ABSOLUTE VALUE OF THE ELEMENTS OF A VECTOR OR A SUBSET OF THE ELEMENTS OF A VECTOR |
| VABMXS | FIND THE MAXIMUM ABSOLUTE VALUE OF THE ELEMENTS OF A ROW (OR COLUMN) OF A MATRIX STORED IN SYMMETRIC STORAGE MODE |
| VABSMF | SUM THE ABSOLUTE VALUES OF THE ELEMENTS OF A VECTOR OR A SUBSET OF A VECTOR |
| VABSMS | SUM THE ABSOLUTE VALUES OF THE ELEMENTS OF A ROW (OR COLUMN) OF A MATRIX STORED IN SYMMETRIC STORAGE MODE |
| VCONVO | PERFORM THE CONVOLUTION OF TWO INPUT SEQUENCES OF DATA USING THE FAST FOURIER TRANSFORM |
| VCVTBF | STORAGE MODE CONVERSION - BAND TO FULL |
| VCVTCH | STORAGE MODE CONVERSION OF MATRICES - FULL COMPLEX TO HERMITIAN |

VCVTFB STORAGE MODE CONVERSION - FULL TO BAND

VCVTFQ STORAGE MODE CONVERSION - FULL TO BAND SYMMETRIC

VCVTFS STORAGE MODE CONVERSION OF MATRICES - FULL TO SYMMETRIC

VCVTHC STORAGE MODE CONVERSION OF MATRICES - HERMITIAN TO FULL COMPLEX

VCVTQF STORAGE MODE CONVERSION - BAND SYMMETRIC TO FULL STORAGE MODE

VCVTQS STORAGE MODE CONVERSION - BAND SYMMETRIC TO SYMMETRIC

VCVTSF STORAGE MODE CONVERSION OF MATRICES - SYMMETRIC TO FULL

VCVTSQ STORAGE MODE CONVERSION - SYMMETRIC TO BAND SYMMETRIC

VDCPS DECOMPOSE AN INTEGER INTO ITS PRIME FACTORS

VHSH2C HOUSEHOLDER TRANSFORMATION - ZERO A SINGLE COMPLEX ELEMENT OF A MATRIX A

VHSH2R HOUSEHOLDER TRANSFORMATION - ZERO A SINGLE ELEMENT OF A MATRIX A

VHSH3R HOUSEHOLDER TRANSFORMATION - ZERO TWO ELEMENTS OF A MATRIX A

VIPRFF VECTOR INNER PRODUCT OF TWO VECTORS OR SUBSETS OF TWO VECTORS

VIPRSS VECTOR INNER PRODUCT OF TWO VECTORS EACH OF WHICH IS PART OF SOME MATRIX STORED IN SYMMETRIC MODE

VMULBB MATRIX MULTIPLICATION - BAND STORAGE MODE

VMULBF MULTIPLICATION OF A MATRIX STORED IN BAND STORAGE MODE AND A MATRIX STORED IN FULL STORAGE MODE

VMULBS MULTIPLICATION OF A BAND MATRIX STORED IN BAND STORAGE MODE AND A SYMMETRIC MATRIX STORED IN SYMMETRIC STORAGE MODE

VMULFB MULTIPLICATION OF A FULL MATRIX BY A BAND MATRIX STORED IN BAND STORAGE MODE

VMULFF MATRIX MULTIPLICATION - FULL STORAGE MODE

VMULFM MATRIX MULTIPLICATION OF THE TRANSPOSE OF MATRIX A BY MATRIX B - FULL STORAGE MODE

VMULFP MATRIX MULTIPLICATION OF MATRIX A BY THE TRANSPOSE OF MATRIX B - FULL STORAGE MODE

VMULFQ MULTIPLICATION OF A MATRIX STORED IN FULL STORAGE MODE AND A BAND SYMMETRIC MATRIX STORED IN BAND SYMMETRIC STORAGE MODE

VMULFS FULL MATRIX BY SYMMETRIC MATRIX MULTIPLICATION

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| VMULCB | MULTIPLICATION OF A BAND SYMMETRIC MATRIX STORED IN BAND SYMMETRIC STORAGE MODE BY A BAND MATRIX STORED IN BAND STORAGE MODE |
| VMULCF | MULTIPLICATION OF A BAND SYMMETRIC MATRIX STORED IN BAND SYMMETRIC STORAGE MODE BY A FULL MATRIX STORED IN FULL STORAGE MODE |
| VMULCQ | MULTIPLICATION OF TWO MATRICES STORED IN BAND SYMMETRIC STORAGE MODE |
| VMULCS | MULTIPLICATION OF A MATRIX STORED IN BAND SYMMETRIC STORAGE MODE BY A MATRIX STORED IN SYMMETRIC STORAGE MODE |
| VMULSB | MULTIPLICATION OF A SYMMETRIC MATRIX STORED IN SYMMETRIC STORAGE MODE BY A BAND MATRIX STORED IN BAND STORAGE MODE |
| VMULSF | MULTIPLICATION OF A MATRIX STORED IN SYMMETRIC STORAGE MODE BY A FULL MATRIX |
| VMULSQ | MULTIPLICATION OF A MATRIX STORED IN SYMMETRIC STORAGE MODE BY A MATRIX STORED IN BAND SYMMETRIC STORAGE MODE |
| VMULSS | MATRIX MULTIPLICATION-SYMMETRIC STORAGE MODE |
| VNRMFI | INFINITY-NORM OF A MATRIX - FULL STORAGE MODE |
| VNRMF1 | 1-NORM OF A MATRIX - FULL STORAGE MODE |
| VNRMF2 | EUCLIDEAN NORM OF A MATRIX - FULL STORAGE MODE |
| VNRMS1 | 1-NORM OF A MATRIX - SYMMETRIC STORAGE MODE |
| VNRMS2 | EUCLIDEAN NORM OF A MATRIX - SYMMETRIC STORAGE MODE |
| VPOLYF | MATRIX POLYNOMIAL EVALUATION - FULL STORAGE MODE |
| VSORTA | SORT ARRAYS BY ALGEBRAIC VALUE (ENTRY IN VSORTM) |
| VSORTM | SORT ARRAYS BY ABSOLUTE VALUE |
| VSORTP | SORT ARRAYS BY ALGEBRAIC VALUE - PERMUTATIONS RETURNED (ENTRY IN VSRTPM) |
| VSORTZ | INTERCHANGE THE ROWS OR COLUMNS OF A MATRIX USING A PERMUTATION VECTOR SUCH AS ONE OBTAINED FROM IMSL ROUTINES VSORTP OR VSRTPM |
| VSRTPM | SORT ARRAYS BY ABSOLUTE VALUE - PERMUTATIONS RETURNED |
| VTPROF | TRANSPOSE PRODUCT OF MATRIX - FULL STORAGE MODE |
| VTPROS | TRANSPOSE PRODUCT OF MATRIX - SYMMETRIC STORAGE MODE |
| VTPAN | TRANSPOSE A RECTANGULAR MATRIX IN PLACE |

VUABQ ADDITION OF A BAND MATRIX STORED IN BAND STORAGE MODE AND A BAND SYMMETRIC MATRIX STORED IN BAND SYMMETRIC STORAGE MODE (MATRIX SUBTRACTION MAY BE DONE VIA THIS ROUTINE IF THE USER (PRIOR TO ENTRY) MANIPULATES THE SIGNS OF THE MATRICES TO GIVE THE DESIRED RESULT)

VUAFB ADDITION OF A MATRIX STORED IN FULL STORAGE MODE AND A MATRIX STORED IN BAND STORAGE MODE (MATRIX SUBTRACTION MAY BE DONE VIA THIS ROUTINE IF THE USER (PRIOR TO ENTRY) MANIPULATES THE SIGNS OF THE MATRICES TO GIVE THE DESIRED RESULT)

VUAFQ ADDITION OF A MATRIX STORED IN FULL STORAGE MODE AND A BAND SYMMETRIC MATRIX STORED IN BAND SYMMETRIC STORAGE MODE (MATRIX SUBTRACTION MAY BE DONE VIA THIS ROUTINE IF THE USER (PRIOR TO ENTRY) MANIPULATES THE SIGNS OF THE MATRICES TO GIVE THE DESIRED RESULT)

VUAFS ADDITION OF A MATRIX STORED IN FULL STORAGE MODE TO A MATRIX STORED IN SYMMETRIC STORAGE MODE (MATRIX SUBTRACTION MAY BE DONE VIA THIS ROUTINE IF THE USER (PRIOR TO ENTRY) MANIPULATES THE SIGNS OF THE MATRICES TO GIVE THE DESIRED RESULT)

VUASB ADDITION OF A MATRIX STORED IN SYMMETRIC STORAGE MODE AND A BAND MATRIX STORED IN BAND STORAGE MODE (MATRIX SUBTRACTION MAY BE DONE VIA THIS ROUTINE IF THE USER (PRIOR TO ENTRY) MANIPULATES THE SIGNS OF THE MATRICES TO GIVE THE DESIRED RESULT)

VUASQ ADDITION OF A SYMMETRIC MATRIX STORED IN SYMMETRIC STORAGE MODE TO A SYMMETRIC BAND MATRIX STORED IN SYMMETRIC BAND STORAGE MODE (MATRIX SUBTRACTION MAY BE DONE VIA THIS ROUTINE IF THE USER (PRIOR TO ENTRY) MANIPULATES THE SIGNS OF THE MATRICES TO GIVE THE DESIRED RESULT)

ZANLYT DETERMINATION OF ZEROS OF AN ANALYTIC COMPLEX FUNCTION USING MULLER'S METHOD WITH DEFLATION

ZBRENT TO FIND A ZERO OF A FUNCTION WHICH CHANGES SIGN IN A GIVEN INTERVAL

ZCPOLY ZEROS OF A POLYNOMIAL WITH COMPLEX COEFFICIENTS (JENKINS-TRAUB)

ZFALSE APPROXIMATE SOLUTION TO F(X)=0

ZPOLR ZEROS OF A POLYNOMIAL WITH REAL COEFFICIENTS (LAGUERRE)

ZQADC FIND THE ROOTS OF THE QUADRATIC EQUATION A*Z**2+B*Z+C = 0.0, WHERE THE COEFFICIENTS A, B, AND C ARE COMPLEX NUMBERS

ZQADR FIND THE ROOTS OF THE QUADRATIC EQUATION A*Z**2+B*Z+C = 0.0, WHERE THE COEFFICIENTS A, B, AND C ARE REAL NUMBERS

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|---|---|
| ZREAL1 | ZREAL1 FINDS THE REAL ZEROS OF A REAL FUNCTION -- USED WHEN INITIAL GUESSES ARE POOR |
| ZREAL2 | ZREAL2 FINDS THE REAL ZEROS OF A REAL FUNCTION -- USED WHEN INITIAL GUESSES ARE GOOD |
| ZPPOLY | ZEROS OF A POLYNOMIAL WITH REAL COEFFICIENTS (JENKINS-TRAUB) |
| ZSRCH | GENERATE K POINTS IN AN N DIMENSIONAL RECTANGLE |
| ZSYSTM | DETERMINATION OF A ROOT OF A SYSTEM OF N SIMULTANEOUS NONLINEAR EQUATIONS IN N UNKNOWNS, F(X)=0, IN VECTOR FORM (N CAN BE 1) |
| ZXFIB | MINIMIZE A UNIMODAL FUNCTION OF ONE INDEPENDENT VARIABLE, WHERE A KNOWN FINITE INTERVAL CONTAINS THE MINIMUM, USING THE FIBONACCI TECHNIQUE |
| ZXMIN | A QUASI-NEWTON ALGORITHM FOR FINDING THE MINIMUM OF A FUNCTION OF N VARIABLES |
| ZXSSQ | A MODIFIED LEVENBERG-MARQUARDT ALGORITHM FOR FINDING THE MINIMUM OF THE SUM OF SQUARES OF M FUNCTIONS OF N VARIABLES |
| ZX1LP | MAXIMIZE A LINEAR FUNCTION SUBJECT TO A SET OF LINEAR CONSTRAINTS (ZX1LP IS DESIGNED TO HANDLE THE PHASE ONE LINEAR PROGRAMMING PROBLEM AND ZX2LP IS DESIGNED TO HANDLE THE PHASE TWO LINEAR PROGRAMMING PROBLEM) |
| ZX2LP | SEE ZX1LP |
| ZX3LP | SOLVE THE LINEAR PROGRAMMING PROBLEM MAX CT*X SUBJECT TO A*X LESS THAN OR EQUAL TO B, AND X GREATER THAN OR EQUAL TO 0 WHERE CT EQUALS C-TRANSPOSE |

## MSL (PROPRIETARY)

THE CDC MATH SCIENCE LIBRARY CONTAINS OVER 300 NUMERICAL MATHEMATICAL ROUTINES COVERING THE FOLLOWING EIGHT AREAS:

- PROGRAMMED ARITHMETIC
- ELEMENTARY FUNCTIONS
- POLYNOMIALS AND SPECIAL FUNCTIONS
- ORDINARY DIFFERENTIAL EQUATIONS
- INTERPOLATION, APPROXIMATION AND QUADRATURE
- LINEAR ALGEBRA
- PROBABILITY, STATISTICS AND TIME SERIES
- NONLINEAR EQUATION SOLVERS

REFERENCE: MATH SCIENCE LIBRARY, VOLUMES 1-8, CDC PUBLICATION NUMBER 60327500.

ROUTINES IN LIBRARY 'MSL' INCLUDE:

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|---|---|
| ACFI | SINGLE CONTINUED FRACTION INTERPOLATION ON TABULAR DATA WITH ARBITRARY SPACING |
| ADR | ADD COEFFICIENTS OF LIKE POWERS OF TWO REAL POYLNOMIALS |
| AITKEN | AITKEN'S INTERPOLATION OF ORDER N-1 (ORDER RANGE FROM 1-9) |
| AMCON | PROVIDE CERTAIN MACHINE AND MATHEMATICAL CONSTANTS AS SINGLE PRECISION NUMBERS OF MAXIMUM ACCURACY |
| ATSM | SELECT A SUBTABLE ORDERED, ACCORDING TO PROXIMITY, OF THOSE POINTS THAT HAVE ABSCISSAE CLOSEST TO A GIVEN VALUE, FROM A MONOTONE ORDERED TABLE |
| BALANC | BALANCE A COMPLEX MATRIX BY THE USE OF DIAGONAL SIMILARITY TRANSFORMATIONS |
| BANFIG | DETERMINE A SPECIFIED NUMBER OF THE SMALLEST EIGENVALUES AND ASSOCIATED EIGENVECTORS OF THE ALGEBRAIC EIGENVALUE PROBLEM A*VI=LAMBDA*B*VI WHERE A IS A SYMMETRIC, NONNEGATIVE DEFINITE, NARROW BAND MATRIX AND B IS A POSITIVE DEFINITE DIAGONAL MATRIX |
| BCHSDC | DECOMPOSE A REAL, SYMMETRIC POSITIVE BAND MATRIX INTO (BANDED) UPPER AND LOWER TRIANGULAR FACTORS |
| BDCWNP | DECOMPOSE A BANDED MATRIX INTO BANDED LOWER AND UPPER TRIANGULAR FACTORS WITH NO PIVOTING |
| BDECOM | DECOMPOSE A BANDED MATRIX B INTO BANDED LOWER AND UPPER TRIANGULAR FACTORS L AND U, WITH IMPLICIT EQUILIBRATION AND PARTIAL PIVOTING |
| BESNIS | EVALUATE A TABLE FOR THE BESSEL FUNCTION I(X) FOR N=0,1,2,3,...,J-1 |
| BESNKS | EVALUATE A TABLE OF VALUES OF THE BESSEL FUNCTION K(X) |

BETAR COMPUTE INCOMPLETE BETA RATIO (OF THE INCOMPLETE BETA FUNCTION AT X,P,Q TO THE COMPLETE BETA FUNCTION AT P,Q)

BFBANP SOLVE LY=B AND UX=Y BY BACK SUBSTITUTIONS - WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS AND, L AND U ARE LOWER AND UPPER TRIANGULAR FACTORS, POSSIBLY OBTAINED FROM BDCWNP

BFBSUM SOLVE LY=B AND UX=Y BY BACK SUBSTITUTIONS - WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS AND, L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM BDECOM

BITERM SOLVE A SYSTEM OF LINEAR EQUATIONS WITH ITERATIVE REFINEMENT FOR SYSTEMS HAVING A BAND COEFFICIENT MATRIX

BITRFM SOLVE, WITH ITERATIVE REFINEMENT, A SYSTEM OF LINEAR EQUATIONS HAVING A BAND COEFFICIENT MATRIX

BITRNP SOLVE, WITH ITERATIVE REFINEMENT, A SYSTEM OF LINEAR EQUATIONS HAVING A BAND COEFFICIENT MATRIX

BITRPD SOLVE A SYSTEM OF LINEAR EQUATIONS WITH ITERATIVE REFINEMENT, GIVEN THE TRIANGULAR DECOMPOSITION

BITWNP SOLVE, WITH ITERATIVE REFINEMENT, A SYSTEM OF LINEAR EQUATIONS HAVING A BAND COEFFICIENT MATRIX

BLCKDQ SOLVE A SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS AT A POINT B, GIVEN THE (INITIAL) VALUES AT A POINT A

BLESCM SOLVE A SYSTEM OF N LINEAR EQUATIONS (WITH M RIGHT-HAND SIDES), HAVING A BAND COEFFICIENT MATRIX

BLSWNP SOLVE A SYSTEM OF LINEAR EQUATIONS (WITH SEVERAL RIGHT-HAND SIDES), HAVING A BAND COEFFICIENT MATRIX, USING NO PIVOTING

BPDITM SOLVE A SYSTEM OF LINEAR EQUATIONS WITH ITERATIVE REFINEMENT - A BANDED, SYMMETRIC SYSTEM WITH POSITIVE DEFINITENESS

BPDSFB SOLVE LY=B AND LTX=Y BY BACK SUBSTIUTIONS - WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS AND L AND LT ARE THE LOWER TRIANGULAR FACTOR AND ITS TRANSPOSE POSSIBLY OBTAINED FROM BCHSDC

BPDSOM SOLVE A POSITIVE DEFINITE SYMMETRIC BAND SYSTEM OF EQUATIONS HAVING M RIGHT-HAND SIDES

BRTLTT COMPUTE THE TEST STATISTIC FOR BARTLETT'S TEST OF HOMOGENEITY OF A GROUP OF VARIANCE ESTIMATES AND DETERMINE THE PROBABILITY OF OBTAINING A VALUE FOR THE TEST STATISTIC LESS THAN THAT OBSERVED

BSJ EVALUATE THE SPHERICAL BESSEL FUNCTION J(X) FOR N=-1,0,...,I

BSUBHT FIND A LEAST SQUARES SOLUTION TO AN OVERDETERMINED SYSTEM THAT HAS BEEN DECOMPOSED USING HOUSEHOLDER TRANSFORMATIONS

BVP SOLVE NONLINEAR P-POINT BOUNDARY VALUE PROBLEM IN ORDINARY DIFFERENTIAL EQUATIONS

CADR ADD COEFFICIENTS OF LIKE POWERS OF TWO COMPLEX POLYNOMIALS

CBAREX EVALUATE C**R FOR C A COMPLEX NUMBER AND R A REAL NUMBER

CCOMPE EVALUATE A POLYNOMIAL HAVING COMPLEX COEFFICIENTS AT A COMPLEX POINT

CCONGR SOLVE THE RECTANGULAR SYSTEM AX-BAR=B-BAR IN THE LEAST SQUARES SENSE, IF NO EXACT SOLUTION EXISTS - A, B-BAR, X-BAR ARE COMPLEX

CDECOM DECOMPOSE A COMPLEX SQUARE MATRIX INTO POWER AND UPPER TRIANGULAR MATRICES WITH PARTIAL PIVOTING AND ROW EQUILIBRATION

CDERIV GIVEN THE COMPLEX COEFFICIENTS OF A POLYNOMIAL, COMPUTE THE COMPLEX COEFFICIENTS OF THE DERIVATIVE POLYNOMIAL

CEL3 COMPUTE THE COMPLETE ELLIPTIC INTEGRAL OF THE THIRD KIND

CFBSUM SOLVE LY=B AND UX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS, WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS WITH COMPLEX ELEMENTS, AND L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM CDECOM

CFCME CONSTRUCT THE MINIMAX POLYNOMIAL THROUGH A DISCRETE, WEIGHTED, SET OF POINTS

CGITRF SOLVE A COMPLEX SYSTEM OF LINEAR EQUATIONS HAVING M RIGHT-HAND SIDE COMPLEX COLUMN VECTORS WITH ITERATIVE REFINEMENT

CGLESM SOLVE A COMPLEX SYSTEM OF LINEAR EQUATIONS HAVING M RIGHT-HAND SIDES

CHEBAP FIND A CLOSE APPROXIMATION TO A MINIMAX FIT OF A GIVEN FUNCTION OVER A GIVEN INTERVAL

CHEBEV EVALUATE A CHEBYCHEV POLYNOMIAL AT A GIVEN POINT

CHIDST PERFORM THE CHI-SQUARE DISTRIBUTION TEST

CHIPRB COMPUTE THE PROBABILITY OF OBTAINING A VALUE OF CHI-SQUARE WHICH IS LESS THAN OR EQUAL TO THE GIVEN VALUE CHI-SQUARE

CHIRAB PERFORM A CHI-SQUARE TEST FOR RUNS ABOVE AND BELOW ZERO - TESTS HYPOTHESIS THAT A SAMPLE OF RANDOM VARIABLES IS OBTAINED FROM A POPULATION WHICH IS SYMMETRICALLY DISTRIBUTED ABOUT ZERO

CHIRUD PERFORM THE CHI-SQUARE TEST FOR RUNS UP AND DOWN

CHSDEC DECOMPOSE A POSITIVE DEFINITE SYMMETRIC MATRIX INTO A LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE

CHSQC FUNCTION TO COMPUTE THE VALUE OF CHI-SQUARE WHEN GIVEN THE EXPECTED AND OBSERVED FREQUENCIES

CHTOL EVALUATE THE DISTANCE OF A POINT TO A LINE

CINPRD COMPUTE THE INNER PRODUCT OF TWO VECTORS HAVING COMPLEX COEFFICIENTS IN DOUBLE PRECISION

CINT GIVEN THE COMPLEX COEFFICIENTS OF A POLYNOMIAL, COMPUTE THE COEFFICIENTS OF THE INTEGRAL POLYNOMIAL

CITERF SOLVE LY=B AND UX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS WITH ITERATIVE REFINEMENT, WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS HAVING COMPLEX ELEMENTS, AND L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM CODECOM - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

CLDIV DIVIDE A POLYNOMIAL WITH COMPLEX COEFFICIENTS BY THE LINEAR EXPRESSION (X+B) WHERE B IS COMPLEX

CMPYR FIND THE PRODUCT OF TWO POLYNOMIALS WHEN ANY OF THE COEFFICIENTS ARE COMPLEX

CNSLVL ESTIMATE THE ERROR PERFORMED IN THE EVALUATION OF A COMPLEX POLYNOMIAL IN THE NEIGHBORHOOD OF ONE OF ITS ROOTS

COMBES COMPUTE A TABLE OF BESSEL FUNCTIONS OF THE FIRST AND SECOND KINDS FOR COMPLEX ARGUMENT AND ORDERS

COMCUB FIND THE SLOPES AT A GIVEN SET OF POINTS OF THE CUBIC SPLINE PASSING THROUGH THE POINTS

COMPEV EVALUATE A REAL POLYNOMIAL AT A COMPLEX POINT

CONRAY PERFORM ARITHMETIC OPERATIONS ON THE OBSERVATIONS OF ONE VARIABLE IN A MULTIPLEXED DATA ARRAY AND A SPECIFIED CONSTANT

CORCOV COMPUTE EITHER THE AUTOCORRELATION COEFFICIENTS OR THE AUTOVARIANCE COEFFICIENTS FOR ONE OF THE VARIABLES IN A MULTIPLEXED DATA ARRAY

COSEVL EVALUATE A COSINE POLYNOMIAL AT A GIVEN POINT

CPDIV PROVIDE THE QUOTIENT AND REMAINDER OBTAINED BY DIVIDING ONE POLYNOMIAL BY ANOTHER - COEFFICIENTS MAY BE COMPLEX

CPOLRT FIND ALL ROOTS OF AN NTH DEGREE POLYNOMIAL HAVING COMPLEX COEFFICIENTS

CPTRAN COORDINATE TRANSLATION SUCH THAT THE POLYNOMIAL P(X) BECOMES P(X+T) - P(X) MAY HAVE COMPLEX COEFFICIENTS.

CQDIV DIVIDE THE COMPLEX POLYNOMIAL BY THE QUADRATIC EXPRESSION (X**2+B*X+C), B AND C COMPLEX

CREV REVERSE THE ORDER OF POLYNOMIAL COEFFICIENTS IN AN ARRAY - COEFFICIENTS MAY BE COMPLEX

CSBR SUBTRACT COEFFICIENTS OF LIKE POWERS OF TWO POLYNOMIALS - COEFFICIENTS MAY BE COMPLEX

CSHRNK COMPUTE THE COEFFICIENTS OF THE POLYNOMIAL P(AX) FROM THE COEFFICIENTS OF THE POLYNOMIAL P(X) - COMPLEX COEFFICIENTS

CUBIC2 FIT A CUBIC TO TWO POINTS, GIVEN THE SLOPE AT EACH

CURV EVALUATE THE MERIT FUNCTION FOR A GIVEN DATA SET

DCBHT REDUCE A GIVEN MATRIX TO UPPER TRIANGULAR FORM BY HOUSEHOLDER TRANSFORMATIONS

DCWNE DECOMPOSE A SQUARE MATRIX INTO LOWER AND UPPER TRIANGULAR MATRICES WITH PARTIAL PIVOTING BUT WITHOUT ROW EQUILIBRATION

DCWNP DECOMPOSE A SQUARE MATRIX INTO LOWER AND UPPER TRIANGULAR MATRICES WITHOUT PIVOTING

DECOM DECOMPOSE A SQUARE MATRIX INTO LOWER AND UPPER TRIANGULAR MATRICES WITH PARTIAL PIVOTING AND ROW EQUILIBRATION

DEIG SOLVE FOR THE EIGENVALUES AND RIGHT EIGENVECTORS OF THE DYNAMICAL SYSTEM AX..+BX.+CX=0 WHERE A, B, C ARE REAL, BUT OTHERWISE GENERAL, MATRICES

DERIV GIVEN THE REAL COEFFICIENTS OF A POLYNOMIAL, COMPUTE THE REAL COEFFICIENTS OF THE DERIVATIVE POLYNOMIAL

DETERM CALCULATE THE DETERMINANT OF A SQUARE MATRIX IN THE FORM D1*(2**D2) USING THE INFORMATION FROM THE SUBROUTINE DECOM

DIFTAB DIFFERENTIATE NUMERICALLY A FUNCTION GIVEN AS A TABLE WITH EQUISPACED ARGUMENTS

DLETE REMOVE SPECIFIED OBSERVATIONS FROM A DATA ARRAY

DRATEX SOLVE NUMERICALLY INITIAL VALUE PROBLEMS IN ORDINARY DIFFERENTIAL EQUATIONS

DSCRPT COMPUTE MEANS, STANDARD DEVIATIONS, VARIANCES, AND COEFFICIENTS OF SKEWNESS AND KURTOSIS FOR MULTIPLEXED DATA ARRAYS

DSCRP2 DETERMINE THE MEDIAN, MINIMUM, MAXIMUM AND RANGE FOR EITHER A SINGLE VARIABLE IN A MULTIPLEXED DATA ARRAY OR ALL THE VARIABLES IN A MULTIPLEXED DATA ARRAY

DTSHFT FURNISH A GUESS OF AN EIGENVALUE TO A COMPLEX HESSENBERG MATRIX

| | |
|---|---|
| EIGCHK | GIVEN AN APPROXIMATE EIGENVALUE/EIGENVECTOR PAIR OF A REAL SYMMETRIC MATRIX A, AND THE MATRIX, AND ESTIMATES OF THE CLOSEST EIGENVALUES TO THE GIVEN EIGENVALUE, PROVIDE ERROR BOUNDS AND POSSIBLY REFINEMENT OF THE EIGENVALUE |
| EIGCO1 | GIVEN AN APPROXIMATION TO AN EIGENVALUE OF A REAL MATRIX HAVING REAL AND DISTINCT ROOTS, CONVERGE TO THE EIGENVALUE-EIGENVECTOR PAIR WHOSE EIGENVALUE IS NEAREST TO THIS APPROXIMATION |
| EIGIMP | REFINE THE EIGENVECTORS OBTAINED FROM SUBROUTINE EIGVCH (WIELANDT INVERSE ITERATION) |
| EIGSYM | FIND ALL EIGENVECTORS OF A REAL, SYMMETRIC MATRIX - SUBSET OF EIGENVECTORS MAY ALSO BE FOUND |
| EIGVCH | COMPUTE THE EIGENVECTORS CORRESPONDING TO A REAL EIGENVALUE OF A REAL UPPER HESSENBERG MATRIX |
| EIG5 | FIND ALL, OR OPTIONALLY A SUBSET OF THE EIGENVALUES OF A GENERAL, REAL-ELEMENTED MATRIX |
| ELF | EVALUATE THE INCOMPLETE ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND |
| ELK | EVALUATE THE COMPLETE ELLIPTIC INTEGRAMS OF THE FIRST AND SECOND KIND |
| EL3 | COMPUTE THE ELLIPTIC INTEGRAL OF THE THIRD KIND |
| ERF | COMPUTE THE ERROR FUNCTION |
| ERFINV | FIND THE INVERSE ERROR FUNCTION - COMPUTE THE UPPER LIMIT OF THE INTEGRAL IN THE ERROR FUNCTION |
| EVREAL | EVALUATE A POLYNOMIAL HAVING REAL COEFFICIENTS AT A REAL VALUE OF THE INDEPENDENT VARIABLE |
| EXRAND | GENERATE RANDOM NUMBERS HAVING A NEGATIVE EXPONENTIAL DISTRIBUTION |
| FABSV | COMPUTE THE VALUE OF THE MODULUS OF A VECTOR |
| FAFRAC | ADD TWO FRACTIONS AND EXPRESS THE RESULT AS A FRACTION IN ITS LOWEST FORM |
| FBSUBM | SOLVE LY=B AND UX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS, WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS, AND U AND L ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM DECOM |
| FBSUBS | SOLVE LY=B AND UX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS, WHERE B IS A COLUMN VECTOR, AND U AND L ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM DECOM |
| FCGM2 | SOLVE THE RECTANGULAR EQUATION SYSTEM AX-BAR=B-BAR IN THE LEAST SQUARES SENSE, IF NO EXACT SOLUTION EXISTS - A, X-BAR, B-BAR ARE COMPLEX |

FCLSQ CONSTRUCT A LEAST SQUARE POLYNOMIAL OF A SPECIFIED DEGREE WHOSE GRAPH APPROXIMATES A SET OF DATA POINTS

FDLSQ CONSTRUCT A LEAST SQUARE POLYNOMIAL APPROXIMATION OF SOME PRE-ASSIGNED DEGREE TO A SET OF DATA POINTS WITH GIVEN WEIGHT WHERE THE POLYNOMIAL IS CONSTRAINED AT N POINTS AND THE DERIVATIVE IS ALSO CONSTRAINED AT THE FIRST M OF THE N POINTS WHERE M <= N

FFRAC CHANGE A VECTOR WITH FRACTIONAL COMPONENTS INTO ONE WITH INTEGER COMPONENTS TIMES A SCALAR FRACTION

FHRNEW CONSTRUCT THE HERMETIAN POLYNOMIAL OF DEGREE N+M+1 THROUGH N+1 COORDINATES WITH DERIVATIVES AT THE FIRST M+1 POINTS

FILTER COMPUTE THE OUTPUTS FROM A MOVING AVERAGE -- AUTOGRESSIVE FILTER - BOTH INPUT AND OUTPUT ARRAYS MAY BE MULTIPLEXED ARRAYS

FITLIN FIND THE BEST FIT LINE - MINIMIZE THE SUM OF THE SQUARES OF THE PEPENDICULAR DISTANCES FROM THE POINTS TO THE LINE

FLGNEW CONSTRUCT THE NTH DEGREE LAGRANGIAN THROUGH N+1 COORDINATES X(I), AF(I)

FLSQFY FIND A LEAST SQUARES POLYNOMIAL OF SPECIFIED DEGREE WHOSE GRAPH APPROXIMATES A SET OF DATA POINTS

FMFRAC MULTIPLY TWO FRACTIONS AND EXPRESS THE RESULT AS A FRACTION IN ITS LOWEST TERMS

FMMX MATRIX-MATRIX MULTIPLICATION

FMTMX MULTIPLY THE TRANSPOSE OF A MATRIX BY A MATRIX ON THE RIGHT

FMTR TRANSPOSE AN M BY N MATRIX

FMTVCX MULTIPLY THE TRANSPOSE OF A COMPLEX MATRIX ON THE RIGHT BY A COMPLEX VECTOR

FMTVX MULTIPLY THE TRANSPOSE OF A MATRIX BY A VECTOR

FMULT1 MULTIPLY A GIVEN NTH DEGREE POLYNOMIAL BY A GIVEN LINEAR FACTOR TO GIVE AN (N+1)TH DEGREE POLYNOMIAL

FMVCX MULTIPLY A COMPLEX MATRIX ON THE RIGHT BY A COMPLEX VECTOR

FMVX MATRIX-VECTOR MULTIPLICATION

FNORM1 NORMALIZE A VECTOR

FOURAP FIND THE LEAST SQUARES APPROXIMATING TRIGONOMETRIC POLYNOMIAL TO A SET OF GIVEN DATA HAVING EQUISPACED ABSCISSAE

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|---|---|
| FOURI | FIND AN INTERPOLATING TRIGONOMETRIC POLYNOMIAL TO A SET OF DATA HAVING EQUISPACED ABSCISSAE |
| FPUR | SUBTRACT FROM A VECTOR ITS COMPONENT ALONG ANOTHER VECTOR |
| GAMAIN | COMPUTE THE INCOMPLETE GAMMA FUNCTION |
| GAMMA | EVALUATE THE GAMMA FUNCTION OF A REAL ARGUMENT X |
| GITREM | SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING M RIGHT-HAND SIDES WITH ITERATIVE REFINEMENT |
| GITRES | SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SODE WITH ITERATIVE REFINEMENT |
| GLESOM | SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING M RIGHT-HAND SIDES |
| GLESOS | SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE |
| GMI | EVALUATE NUMERICALLY A SINGLE, DOUBLE OR M-TUPLE (M.LE.10) INTEGRAL OF AN ARBITRARY INTEGRAND BETWEEN ARBITRARY LIMITS |
| HANKEL | EVALUATE THE COMPLEX-VALUED HANKEL FUNCTION OF THE FIRST OR SECOND KIND FOR REAL ARGUMENT AND INTEGER ORDER |
| HARM | COMPUTE A FINITE DISCRETE COMPLEX FOURIER TRANSFORM OF A ONE-, TWO- OR THREE-DIMENSIONAL ARRAY OF COMPLEX FOURIER AMPLITUDES |
| HCF | FIND THE HIGHEST COMMON FACTOR OF TWO INTEGERS |
| HELP | CALCULATE THE ROOTS OF A POLYNOMIAL HAVING COMPLEX COEFFICIENTS |
| HERMIT | EVALUATE THE INTEGRAL OF E**(-X**2)F(X)DX FROM NEGATIVE TO POSITIVE INFINITY WITH F(X) A REAL FUNCTION OF ONE VARIABLE |
| HRMT1 | PERFORM INTERPOLATION, GIVEN A VALUE OF THE INDEPENDENT VARIABLE AND A TABLE OF CORRESPONDING VALUES OF THE INDEPENDENT AND DEPENDENT VARIABLE AND ITS DERIVATIVE - EXTRAPOLATION IS ALLOWED |
| HRMT2 | PERFORM HERMITE INTERPOLATIONS, GIVEN AN ARRAY OF VALUES OF THE INDEPENDENT VARIABLE, AND A TABLE OF CORRESPONDING VALUES OF THE INDEPENDENT AND THE DEPENDENT VARIABLE AND ITS DERIVATIVE |
| HSSN | REDUCE A GENERAL REAL MATRIX TO AN UPPER HESSENBERG FORM BY A SIMILARITY TRANSFORMATION AND PROVIDE THE ELEMENTS IF THE TRANSFORMATION MATRIX |
| HSTGRM | DETERMINE THE NUMBER OF OBSERVATIONS OF A RANDOM VARIABLE WHICH LIE IN USER SPECIFIED INTERVALS - USED FOR DISTRIBUTION TESTS AND FOR PLOTTING HISTOGRAMS |

INPPRD COMPUTE THE INNER PRODUCT OF TWO VECTORS

INT GIVEN THE REAL COEFFICIENTS OF A POLYNOMIAL, COMPUTE THE COEFFICIENTS OF THE INTEGRAL POLYNOMIAL

INVERS FIND THE INVERSE OF A SQUARE MATRIX USING DECOM AND FBSUBM

INVITR FIND THE INVERSE OF A SQUARE MATRIX WITH ITERATIVE REFINEMENT

IRAND GENERATE RANDOM INTEGERS BETWEEN TWO GIVEN VALUES - EACH OF THE INTEGERS BETWEEN THE GIVEN LIMITS HAS AN EQUAL PROBABILITY OF OCCURRING

ITERFM SOLVE LY=B AND LX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS WITH AN INTERATIVE REFINEMENT, WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS, AND L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM DECOM - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITERFS SOLVE LY=B AND LX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS WITH AN INTERATIVE REFINEMENT, WHERE B IS A COLUMN VECTOR, AND L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM DECOM - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITERIN PERFORM THE ITERATIVE REFINEMENT FOR THE INVERSE OF A SQUARE MATRIX

ITRLSQ PERFORM THE ITERATIVE REFINEMENT OF A LEAST SQUARES SOLUTION OBTANED FROM THE SUBROUTINE BSUBHT

ITRPDM SOLVE LY=B AND UX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS WITH AN ITERATIVE REFINEMENT FOR A POSITIVE DEFINITE SYSTEM AX=B (B IS A MATRIX CONSISTING OF M COLUMN VECTORS AND L AND U APE THE LOWER TRIANGLE MATRIX AND ITS TRANSPOSE OBTAINED FROM CHSDEC) - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITRPDS SOLVE LY=B AND UX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS WITH AN ITERATIVE REFINEMENT FOR A POSITIVE DEFINITE SYSTEM AX=B (B IS A COLUMN VECTOR AND L AND U ARE THE LOWER TRIANGLE MATRIX AND ITS TRANSPOSE OBTAINED FROM CHSDEC) - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITRSPM SOLVE LY=B AND DLTX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS WITH ITERATIVE REFINEMENT (WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS, AND L AND LT ARE A LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE, D IS A DIAGONAL MATRIX, OBTAINED FROM SPDCOM) - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITRSPS SOLVE LY=B AND DLTX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS WITH ITERATIVE REFINEMENT (WHERE B IS A COLUMN VECTOR, AND L AND LT ARE A LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE, D IS A DIAGONAL MATRIX, OBTAINED FROM SPDCOM) - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

LAGDIF DIFFERENTIATE NUMERICALLY A TABULAR FUNCTION, AT ANY POINT

LAGINT PERFORM LAGRANGIAN INTERPOLATION AT A GIVEN ABSCISSA

LAGRAN EVALUATE THE INTEGRAL OF A REAL FUNCTION OF ONE VARIABLE, GIVEN THE ARRAYS OF THE INDEPENDENT AND THE DEPENDENT VARIABLES

LAGUER EVALUATE THE INTEGRAL OF F(X)DX FROM A TO E**-X WITH F(X) A REAL FUNCTION OF ONE VARIABLE AND E**-X THE WEIGHTING FN

LATNTR FIND THE EIGENVALUES (REAL AND COMPLEX) OF A REAL MATRIX

LCM FIND THE LEAST COMMON MULTIPLE OF TWO INTEGERS

LDIV DIVIDE A POLYNOMIAL WITH REAL COEFFICIENTS BY THE LINEAR EXPRESSION (X+B) - B IS REAL

LEGEN EVALUATE THE INTEGRAL OF A REAL FUNCTION OF ONE VARIABLE OVER A FINITE INTERVAL, WHEN THE FUNCTION GENERATOR IS GIVEN

LESWNE SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITH PARTIAL PIVOTING BUT WITHOUT ROW EQUILIBRATION - PROVIDE DATA FOR CALCULATING THE DETERMINANT

LESWNP SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITHOUT PIVOTING

LINPVP SOLVE NUMERICALLY LINEAR P-POINT BOUNDARY POINT PROBLEMS IN N FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

LINSYS SOLVE GENERAL SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS - PROVIDE THE DATA TO EVALUATE READILY THE DETERMINANT OF THE COEFFICIENT MATRIX

LITWNE SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITH ITERRATIVE REFINEMENT, WITH PARTIAL PIVOTING, WITHOUT ROW EQUILIBRATION - PROVIDE THE DATA FOR CALCULATING THE DETERMINANT AND THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX

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|---|---|
| LITWNP | SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITH ITERATIVE REFINEMENT AND WITHOUT PIVOTING |
| LOGGAM | COMPUTE THE NATURAL LOGARITHM OF THE GAMMA FUNCTION FOR COMPLEX ARGUMENT |
| LSCHTM | SOLVE LINEAR LEAST SQUARES PROBLEMS FOR AN OVERDETERMINED SYSTEM WITH K RIGHT-HAND SIDES BY HOUSEHOLDER TRANSFORMATIONS |
| LSCHTS | SOLVE LINEAR LEAST SQUARES PROBLEMS FOR AN OVERDETERMINED SYSTEM WITH ONE RIGHT-HAND SIDE BY HOUSEHOLDER TRANSFORMATIONS |
| LSQSIT | SOLVE LINEAR LEAST SQUARES PROBLEMS BY HOUSEHOLDER TRANSFORMATION, USING ITERATIVE REFINEMENT |
| MIGEN | FIND A MINIMAX FUNCTION APPROXIMATION TO A SET OF POINTS IN TERMS OF A LINEAR COMBINATION OF A PRESCRIBED SET OF FUNCTIONS |
| MILN2 | SMOOTH A SET OF DATA BY AN AVERAGING PROCESS |
| MINRAT | FIND A MINIMAX RATIONAL FUNCTION APPROXIMATION OF GIVEN DEGREE TO A SET OF POINTS |
| MPYR | FIND THE PRODUCT OF TWO POLYNOMIALS WHEN THE COEFFICIENTS ARE ALL REAL |
| MULLP | FIND ALL ZEROS OR A SINGLE ZERO OF A POLYNOMIAL HAVING COMPLEX COEFFICIENTS |
| NBESJ | COMPUTE BESSEL FUNCTIONS OF FIRST KIND FOR REAL ARGUMENT AND INTEGER ORDERS |
| NEWT | SOLVE A SYSTEM OF NON-LINEAR EQUATIONS |
| NONLIQ | SOLVE A SYSTEM OF NON-LINEAR ALGEBRAIC EQUATIONS |
| NRAND | GENERATE PSEUDO-RANDOM NUMBERS WHICH ARE NORMALLY DISTRIBUTED AND STORE VALUES IN A MULTIPLEXED ARRAY |
| NRICH | ENRICH A SET OF POINTS BY ADDING POINTS ON AN INTERPOLATING CURVE THROUGH THE GIVEN POINTS |
| NRKVS | SOLVE A SYSTEM OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS AT A POINT B WITH INITIAL VALUES GIVEN AT A POINT A |
| NRKVSH | SOLVE A SYSTEM OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS AT A POINT B WITH INITIAL VALUES GIVEN AT A POINT A |
| NRML | GENERATE PSEUDO-RANDOM NUMBERS HAVING A NORMAL DISTRIBUTION |
| NRMND | GENERATE NORMALLY DISTRIBUTED PSEUDO-RANDOM NUMBERS WITH A CONVENIENT WAY OF HANDLING THE TAIL OF THE DISTRIBUTION - STORE THOSE NUMBERS IN A MULTIPLEXED DATA ARRAY |

NRSG SOLVE M BY N SYSTEM OF NON-LINEAR EQUATIONS

NSLVL ESTIMATE THE ERROR PERFORMED IN THE EVALUATION OF A REAL POLYNOMIAL AT A COMPLEX POINT IN THE NEIGHBORHOOD OF ONE OF ITS ROOTS

OP1RAY PERFORM ONE OF NINE POSSIBLE TRANSFORMATIONS ON THE OBSERVATIONS OF A SINGLE VARIABLE IN A MULTIPLEXED DATA ARRAY

OP2RAY PERFORM AN ARITHMETIC OPERATION (+, -, *, /, **) ON THE CORRESPONDING OBSERVATIONS OF TWO VARIABLES STORED IN MULTIPLEXED DATA ARRAYS

ORTHFT FIT A GIVEN SET OF POINTS WITH A LINEAR COMBINATION OF PRESCRIBED GENERAL FUNCTIONS OF LINEARLY INDEPENDENT VARIABLE(S)

ORTHON GIVEN A SET OF N LINEARLY INDEPENDENT REAL VECTORS OF DIMENSION M, CONSTRUCT A SET WHICH SPANS THE SAME SUBSPACE AND WHOSE VECTORS ARE ORTHONORMAL WITH RESPECT TO A DEFINED INNER PRODUCT

PADE APPROXIMATE FUNCTIONS WHICH HAVE MACLAURIN SERIES EXPANSIONS BY RATIONAL FUNCTIONS USING PADE APPROXIMATIONS

PARBL EVALUATE THE INTEGRAL OF A BOUNDED REAL FUNCTION OF ONE REAL VARIABLE OVER A FINITE INTERVAL

PARFAC RESOLVE A RATIONAL FUNCTION INTO PARTIAL FRACTIONS

PBETA COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FVOM A BETA DISTRIBUTION

PBINOM COMPUTE THE CUMULATIVE PROBABILITY FOR THE BINOMIAL DISTRIBUTION

PCHY COMPUTE THE CUMULATIVE PROBABILITY FOR THE CAUCHY DISTRIBUTION

PDITRM SOLVE A POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS AX=B HAVING M RIGHT-HAND SIDES

PDITRS SOLVE A POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS AX=B HAVING ONE RIGHT-HAND SIDE

PDIV PROVIDE THE QUOTIENT AND REMAINDER OBTAINED BY DIVIDING ONE POLYNOMIAL BY ANOTHER - COEFFICIENTS ARE REAL

PDLSOM SOLVE A POSITIVE DEFINITE SYSTEM AX=B HAVING M RIGHT-HAND SIDES USING THE CHOLESKY DECOMPOSITION

PDLSOS SOLVE A POSITIVE DEFINITE SYSTEM AX=B HAVING ONE RIGHT-HAND SIDE USING THE CHOLESKY DECOMPOSITION

PDSFBM SOLVE LY=B AND UX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS FOR A POSITIVE DEFINITE SYSTEM AX=B - B IS A MATRIX OF M COLUMN VECTORS AND L AND U ARE THE LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE OBTAINED FROM CHSDEC

PDSFBS SOLVE LY=B AND UX=Y BY FORWARD AND BACKWARD SUBSTITUTIONS FOR A POSITIVE DEFINITE SYSTEM AX=B - B IS A COLUMN VECTOR AND L AND U ARE THE LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE OBTAINED FROM CHSDEC

PFDIST COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM AN F- (VARIANCE-RATIO) DISTRIBUTION

PGEOM COMPUTE THE CUMULATIVE PROBABILITY FOR THE GEOMETRIC DISTRIBUTION

PGMMA COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM A GAMMA DISTRIBUTION

PHYPGE COMPUTE THE CUMULATIVE PROBABILITY FOR THE HYPERGEOMETRIC DISTRIBUTION

PIBETA DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A BETA DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIBIN DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A BINOMIAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PICHI DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A CHI-SQUARE DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PICHY DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A CAUCHY DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIEXP DETERMINE THE VALUE OF AN EXPONENTIALLY DISTRIBUTED RANDOM VARIABLE WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIFDIS DETERMINE THE VALUE OF A RANDOM VARIABLE FROM AN F DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIGAMA DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A GAMMA DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIGEO DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A GEOMETRIC DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIHYPG DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A HYPERGEOMETRIC DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PILGNM DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A LOG-NORMAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PINBIN DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A NEGATIVE BIMONIAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PINCRM DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A NORMAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIPOIS DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A POISSON DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIRAYL DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A RAYLEIGH DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIT DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A STUDENT'S T DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PITRNM DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A TRUNCATED NORMAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIUNF DETERMINE THE VALUE OF A UNIFORMLY DISTRIBUTED, RANDOM VARIABLE WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIUNFD DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A UNIFORM DISCRETE DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIWEBL DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A WEIBULL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PLAGR FORMS AND READS, AT A GIVEN STATION X, THE POLYNOMIAL PASSING THROUGH ALL OF A GIVEN SET OF POINTS

PLGNRM COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM A LOG-NORMAL DISTRIBUTION

PNBIN COMPUTE THE CUMULATIVE PROBABILITY FOR THE NEGATIVE BINOMIAL DISTRIBUTION

PNORM COMPUTE THE CUMULATIVE PROBABILITY FOR A NORMAL DISTRIBUTION

PORAND GENERATE RANDOM INTEGERS HAVING THE POISSON DISTRIBUTION

PRAYL COMPUTE THE CUMULATIVE PROBABILITY FOR THE RAYLEIGH DISTRIBUTION

PRBEXP DETERMINE THE PROBABILITY OF OBTAINING A VARIABLE HAVING VALUE = X0 FROM A POPULATION HAVING AN EXPONENTIAL DISTRIBUTION

PRBUNF DETERMINE THE PROBABILITY OF OBTAINING A VARIABLE HAVING VALUE = X0 FROM A POPULATION HAVING A UNIFORM DISTRIBUTION

PRDSUM COMPUTE THE INNER PRODUCT OF TWO VECTORS AND ADD IT TO AN INCOMING VALUE C

PRICH ENRICH A GIVEN ARRAY WHICH DEFINES A CURVE BY INSERTING POINTS SO AS TO OPTIMIZE THE MERIT FUNCTION DEFINED IN CURV

PRONY CONSTRUCT AN APPROXIMATION WHICH IS THE SUM OF A PRESCRIBED NUMBER OF EXPONENTIALS TO A SET OF N DATA POINTS

PROCT FIND ALL REAL AND COMPLEX ROOTS OF A POLYNOMIAL WITH REAL COEFFICIENTS BY THE METHOD OF BAIRSTOW-NEWTON

PTDIST COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM A T- (STUDENT'S) DISTRIBUTION

PTRAN COORDINATE TRANSLATION SUCH THAT POLYNOMIAL P(X) BECOMES P(X+T) - P(X) HAS REAL COEFFICIENTS

PTRNRM COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM A TRUNCATED NORMAL DISTRIBUTION IN THE RANGE BETWEEN A AND B

PUNFD COMPUTE THE CUMULATIVE PROBABILITY FOR THE DISCRETE UNIFORM DISTRIBUTION

PWEBL COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM A WEIBULL DISTRIBUTION

QDIV DIVIDE A REAL POLYNOMIAL BY THE QUADRATIC EXPRESSION (X**2+B*X+C), B AND C REAL

QNWT SOLVE SYSTEMS OF NON-LINEAR ALGEBRAIC OF TRANSCENDENTAL EQUATIONS

QREIG FIND ALL EIGENVALUES OF A COMPLEX MATRIX

QR1 PERFORM A SINGLE, COMPLEX QR-ITERATON ON A MATRIX IN UPPER HESSENBERG FORM, HAVING REAL SUBDIAGONAL ELEMENTS

QUAD PERFORM NUMERICAL QUADRATURE ON BOTH WELL-BEHAVED AND POORLY-BEHAVED FUNCTIONS

RAND GENERATE UNIFORMLY DISTRIBUTED OR NORMALLY DISTRIBUTED RANDOM NUMBERS

RATL COMPUTE THE COEFFICIENTS OF THE LEAST SQUARES APPROXIMATION TO A SET OF DISCRETE DATA BY A RATIONAL FUNCTION

RAYLGH COMPUTE THE RAYLEIGH QUOTIENT FOR REAL SYMMETRIC MATRICES

RBESY COMPUTE BESSEL FUNCTION OF SECOND KIND FOR POSITIVE REAL ARGUMENT AND INTEGER ORDERS

RECOV1 RECOVER EIGENVECTORS AFTER A REDUCTION USING A TRIANGULAR MATRIX IN THE SIMILARITY TRANSFORMATION

RECOV2 RECOVER EIGENVECTORS OF THE EIGENPROBLEMS BAY=LAMBDAY OR YTAB=LAMBDAYT, WHERE A, B ARE REAL, SYMMETRIC AND B IS POSITIVE DEFINITE

REDSYS1 REDUCE THE EIGENPROBLEM (A-LAMBDAB)X=0 TO A STANDARD SYMMETRIC PROBLEM (P-LAMBDAI)Z=0 - A MUST BE REAL SYMMETRIC, B MUST BE REAL SYMMETRIC POSITIVE DEFINITE TO ALLOW THE DECOMPOSITION B=LLT

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|---|---|
| REDSYS2 | REDUCE TO STANDARD FORM THE EIGENPROBLEMS (AB-LAMBDAI)X=0 OR (BA-LAMBDAI)Y=0, WHERE A, B ARE REAL SYMMETRIC AND B IS POSITIVE DEFINITE |
| REV | REVERSE THE ORDER OF REAL POLYNOMIAL COEFFICIENTS IN AN ARRAY |
| RICH | ENRICH A GIVEN CURVE DEFINED BY AN ARRAY OF POINTS SO AS TO SATISFY A SPECIFIED CHORD HEIGHT TOLERANCE |
| RKINIT | SOLVE A SYSTEM OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS AT A POINT B WITH INITIAL VALUES GIVEN AS A POINT A |
| ROMBG | EVALUATE THE INTEGRAL OF A REAL FUNCTION OF ONE REAL VARIABLE OVER A FINITE INTERVAL USING ROMBERG INTEGRATION |
| RONWT | USES QNWT TO SOLVE SYSTEMS OF NONLINEAR, ALGEBRAIC OR TRANSCENDENTAL EQUATIONS (IT APPEARS TO BE USEFUL IN THAT IT DOES NOT GIVE UP ON DIFFICULT PROBLEMS AS EASILY AS OTHER MSL SUBROUTINES - QNWT SOLVED 34 OF 40 TEST CASES, RQNWT SOLVED ALL 40) |
| RUNSAB | COUNT THE NUMBER OF RUNS ABOVE AND BELOW ZERO OF DIFFERENT LENGTHS AND THE EXPECTED NUMBER OF RUNS FOR A SAMPLE WHICH IS RANDOMLY SELECTED FROM A POPULATION SYMMETRICALLY DISTRIBUTED ABOUT ZERO |
| RUNSUD | COUNT THE RUNS UP AND DOWN OF DIFFERENT LENGTHS IN A SAMPLE AND DETERMINE THE EXPECTED NUMBER OF RUNS OF DIFFERENT LENGTHS FOR A RANDOM SAMPLE |
| SBP | SUBTRACT COEFFICIENTS OF LIKE POWERS OF TWO REAL POLYNOMIALS |
| SCONG | SOLVE THE EQUATION SYSTEM AX-BAR=B-BAR BY THE CONJUGATE GRADIENT METHOD - DESIGNED TO BE USED WHEN THE MATRIX A IS LARGE BUT HAS MANY ZERO ELEMENTS |
| SEARCH | USED IN THE TBLU PACKAGE TO PERFORM A BINARY TABLE SEARCH |
| SEPAR | FIND ALL EIGENVALUES OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX |
| SEPAR2 | FIND A SUBSET OF EIGENVALUES OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX |
| SHRINK | COMPUTE THE COEFFICIENTS OF THE POLYNOMIAL P(AX) FROM THE COEFFICIENTS OF THE POLYNOMIAL P(X) - REAL COEFFICIENTS |
| SICI | EVALUATE THE SINE AND COSINE INTEGRALS |
| SIGSM | PERFORM SMOOTHING OF A TRIGONOMETRIC SERIES BY USE OF LANCZOS SIGMA-FACTORS |
| SIMP | TRANSFORM EIGENVECTORS OF AN UPPER HESSENBERG MATRIX H, WHERE H=(P**-1)AP, TO EIGENVECTORS OF THE SIMILAR MATRIX A |
| SIMPRC | EVALUATE THE INTEGRAL OF ANY FUNCTION Y=F(X) BETWEEN THE LIMITS A AND B USING SIMPSON'S RULE |

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|---|---|
| SINEVL | EVALUATE A SINE POLYNOMIAL AT A GIVEN POINT |
| SINSER | INTERPOLATE A SET OF N (ABSCISSA,ORDINATE)-PAIRS |
| SMOCUB | PERFORM SMOOTHING |
| SMOOTH | COMPUTE A VECTOR OF SMOOTHED FUNCTION VALUES GIVEN VECTORS OF ARGUMENT AND CORRESPONDING FUNCTION VALUES |
| SMTVX | MULTIPLY THE TRANSPOSE OF A LARGE, SPARSE MATRIX BY A VECTOR |
| SMVX | MATRIX-VECTOR MULTIPLICATION WHEN THE MATRIX IS LARGE AND SPARSE |
| SPDCOM | DECOMPOSE A POSITIVE DEFINITE SYMMETRIC MATRIX WITHOUT USING THE SQUARE ROOT ROUTINE |
| SPDFBM | SOLVE LY=B AND X=Y BY FORWARD AND BACKWARD SUBSTITUTIONS FOR A POSITIVE DEFINITE SYSTEM AX=B (B IS A MATRIX OF M COLUMN VECTORS, AND L AND U ARE THE LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE, AND D THE DIAGONAL MATRIX OBTAINED FROM SPDCOM) |
| SPDFBS | SOLVE LY=B AND X=Y BY FORWARD AND BACKWARD SUBSTITUTIONS FOR A POSITIVE DEFINITE SYSTEM AX=B (B IS A COLUMN VECTOR, AND L AND U ARE THE LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE, AND D THE DIAGONAL MATRIX OBTAINED FROM SPDCOM) |
| SPDSOM | SOLVE A POSITIVE DEFINITE SYSTEM AX=B HAVING M RIGHT-HAND SIDES WITHOUT USING THE SQUARE ROOT ROUTINE |
| SPDSOS | SOLVE A POSITIVE DEFINITE SYSTEM AX=B HAVING ONE RIGHT-HAND SIDE WITHOUT USING THE SQUARE ROOT ROUTINE |
| SPITRM | SOLVE A POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS WITHOUT USING THE SQUARE ROOT ROUTINE WITH ITERATIVE REFINEMENT |
| SPITRS | SOLVE A POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS WITHOUT USING THE SQUARE ROOT ROUTINE WITH ITERATIVE REFINEMENT |
| SPLINE | CONSTRUCT A 5TH DEGREE SPLINE INTERPOLATING A SET OF EQUISPACED DATA |
| START | READ IN AND LIST INPUT DATA WHICH IS TO BE ENRICHED BY USING OTHER MSL ROUTINES |
| SUBDIA | REDUCE A COMPLEX MATRIX TO UPPER HESSENBERG FORM BY SIMILARITY TRANSFORMATIONS, USING UNITARY MATRICES |
| SUBDIR | REDUCE A REAL MATRIX TO UPPER HESSENBERG FORM |
| SUMPS | COMPUTE DOUBLE PRECISION SUMS OF THE POWERS OF OBSERVATIONS |
| SURFS | FIT A SMOOTH SURFACE WITH CONTINUOUS FIRST PARTIAL DERIVATIVES TO A SET OF POINTS DEFINED OVER A RECTANGULAR GRID |
| SYMLR | FIND ALL EIGENVALUES OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX |

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|---|---|
| SYMQR | FIND ALL EIGENVALUES OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX |
| TBLU1 | TABLE SEARCH AND INTERPOLATION WITH ONE INDEPENDENT VARIABLE |
| TBLU2 | TABLE SEARCH AND INTERPOLATION WITH TWO INDEPENDENT VARIABLES |
| TBLU3 | TABLE SEARCH AND INTERPOLATION WITH THREE INDEPENDENT VARIABLES |
| TCDIAG | COMPUTE PARTIAL OR COMPLETE EIGENSYSTEMS OF HERMETIAN MATRICES |
| TERP1 | POLYNOMIAL INTERPOLATION FOR ONE INDEPENDENT VARIABLE |
| TERP2 | POLYNOMIAL INTERPOLATION FOR TWO INDEPENDENT VARIABLES |
| TERP3 | POLYNOMIAL INTERPOLATION FOR THREE INDEPENDENT VARIABLES |
| TRDCNP | PERFORM TRIANGULAR DECOMPOSITION OF A TRIDIAGONAL MATRIX WITHOUT PIVOTING |
| TRDCOM | PERFORM TRIANGULAR DECOMPOSITION OF A TRIDIAGONAL MATRIX WITH PARTIAL PIVOTING |
| TRDFBM | PERFORM BACK SUBSTITUTION |
| TRDSOM | SOLVE A TRIDIAGONAL SYSTEM OF EQUATIONS USING TRIANGULAR DECOMPOSITION WITH PARTIAL PIVOTING AND BACK SUBSTITUTION |
| TRDSUB | PERFORM BACK SUBSTITUTION |
| TRDWNP | SOLVE A TRIDIAGONAL SYSTEM OF EQUATIONS USING TRIANGULAR DECOMPOSITION WITHOUT PIVOTING AND BACK SUBSTITUTION |
| TRGDIF | DIFFERENTIATE FORMALLY A TRIGONOMETRIC POLYNOMIAL |
| TRGINT | INTEGRATE FORMALLY A TRIGONOMETRIC POLYNOMIAL |
| TRIDI | REDUCE A REAL, SYMMETRIC MATRIX TO TRIDIAGONAL FORM BY USE OF HOUSEHOLDER'S REDUCTION |
| TRILOM | SOLVE A LOWER TRIANGULAR SYSTEM LX=B WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS |
| TRILOS | SOLVE A LOWER TRIANGULAR SYSTEM LX=B WHERE B IS A SINGLE COLUMN VECTOR |
| TRIUPM | SOLVE AN UPPER TRIANGULAR SYSTEM UX=B WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS |
| TRIUPS | SOLVE AN UPPER TRIANGULAR SYSTEM UX=B WHERE B IS A SINGLE COLUMN VECTOR |
| TRLOIN | INVERT A LOWER TRIANGULAR MATRIX |
| TRUPIN | INVERT AN UPPER TRIANGULAR MATRIX |

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| UNCSPL | CONSTRUCT A NONLINEAR CUBIC SPLINE WITH CONTINUOUS SECOND DERIVATIVE THROUGH A GIVEN SET OF DATA |
| URAND | GENERATE UNIFORMLY DISTRIBUTED PSEUDO-RANDOM NUMBERS WITH THE SPECIFIED UPPER AND LOWER LIMITS AND STORE VALUES AS ONE VARIABLE IN A MULTIPLEXED DATA ARRAY |
| VALVEC | FIND ALL (OR A SUBSET OF) EIGENVECTORS OF A COMPLEX MATRIX |
| VARORD | ARRANGE THE OBSERVATIONS OF ONE OF THE VARIABLES IN A MULTIPLEXED DATA ARRAY SO THAT THESE OBSERVATIONS ARE STORED IN INCREASING ORDER |
| VECORD | ORDER A SET OF COMPLEX NUMBERS ACCORDING TO MAGNITUDE, EITHER INCREASING OR DECREASING |
| VECTOR | GIVEN A GOOD APPROXIMATION TO AN EIGENVALUE OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX, FIND THE CORRESPONDING EIGENVECTOR AND TRANSFORM THE RESULT ACCORDING TO STORED INFORMATION ABOUT THE ORIGINAL, FULL MATRIX |
| VIP | COMPUTE THE INNER PRODUCT OF TWO VECTORS |
| VIPA | COMPUTE THE INNER PRODUCT OF TWO VECTORS AND ADD IT TO AN INCOMING VALUE C |
| VIPD | COMPUTE THE INNER PRODUCT OF TWO VECTORS WITH DOUBLE PRECISION ACCUMULATION |
| VIPDA | COMPUTE THE INNER PRODUCT OF TWO VECTORS WITH DOUBLE PRECISION ACCUMULATION AND ADD IT TO AN INCOMING VALUE C |
| VIPDS | COMPUTE THE INNER PRODUCT OF TWO VECTORS WITH DOUBLE PRECISION ACCUMULATION AND SUBTRACT IT FROM AN INCOMING VALUE C |
| XIRAND | GENERATE RANDOM FLOATING POINT NUMBERS BETWEEN TWO GIVEN VALUES - EACH OF THE FLOATING POINT NUMBERS BETWEEN THE GIVEN LIMITS HAS AN EQUAL PROBABILITY OF OCCURRING |
| XPLOT | PRINTER PLOT OF UP TO 5 VARIABLES OR SETS OF DATA (ORDINATE) IN THE ORDER IN WHICH THE VALUES ARE STORED (ABSCISSA) |
| XYPLOT | PRINTER PLOT OF UP TO 5 ORDINATE VARIABLES VERSUS A SINGLE ABSCISSA VARIABLE WHERE THE NUMBER OF VALUES FOR THE ABSCISSA IS THE SAME AS THE NUMBER OF VALUES FOR EACH OF THE ORDINATE VARIABLES |
| ZAFUJ | FIND N ZEROS OF AN ARBITRARY COMPLEX-VALUED FUNCTION OF A COMPLEX VARIABLE |
| ZAFUM | FIND N ZEROS OF AN ARBITRARY COMPLEX-VALUED FUNCTION OF A COMPLEX VARIABLE |
| ZAFUR | FIND N ZEROS OF AN ARBITRARY REAL-VALUED FUNCTION OF A REAL VARIABLE |

ZCOUNT COUNT THE NUMBER OF TIMES A FUNCTION F(Z) CIRCLES THE ORIGIN AS Z TRANSVERSES ANY CONTOUR MADE UP OF STRAIGHT LINE SEGMENTS IN A COMPLEX PLANE, AND HENCE THE NUMBER OF ZEROS OF F(Z) WITHIN CLOSED CONTOURS (IF THERE ARE POLES WITHIN THE CONTOUR THEN THE PHRASE "NUMBER OF ZEROS" SHOULD BE REPLACED BY "NUMBER OF ZEROS - NUMBER OF POLES")

ZRNM COMPUTE THE MEAN VALUE OF A SET OF OBSERVATIONS AND SUBTRACTS THE MEAN FROM EACH OF THE OBSERVATIONS

## NSRDC

'NSRDC' IS A LIBRARY OF DTNSRDC WRITTEN AND/OR SUPPORTED SCIENTIFIC AND UTILITY SUBPROGRAMS.

REFERENCES: MOST OF THESE ROUTINES ARE DOCUMENTED IN CCLIB/N, WHICH MAY BE OBTAINED FROM USER SERVICES. THE OTHER DOCUMENTS ARE ON FILE IN USER SERVICES.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROGRAM 'PROGDOC' (SEE PAGE 1-2).

ROUTINES IN LIBRARY 'NSRDC' INCLUDE:

| | |
|---|---|
| AC | GET ACCOUNT NUMBER FOR THIS JOB |
| ADJL | LEFT ADJUST A LINE OF WORDS LEAVING ONE SPACE BETWEEN WORDS |
| ADJR | RIGHT ADJUST A LINE OF WORDS LEAVING ONE SPACE BETWEEN WORDS |
| AI | AIRY FUNCTION INTEGRAL |
| ALTIME | OBTAIN CPA, CPB, CP, PP, IO AND WALL CLOCK TIMES SINCE START OF JOB (OR INTERCOM SESSION) |
| AMAXE | FIND MAXIMUM VALUE OF AN ARRAY (ALSO CONTAINS MAXE) |
| AMINE | FIND MINIMUM VALUE OF AN ARRAY (ALSO CONTAINS MINE) |
| ANOVA1 | ONE-WAY ANALYSIS OF VARIANCE WITH UNEQUAL N |
| ANOVA2 | TWO-WAY ANALYSIS OF VARIANCE WITH EQUAL N |
| APOWR | EXPONENTIATION OF POWER SERIES - ONE VARIABLE |
| ARDCET | PROPERITES OF U.S. STANDARD ATMOSPHERE (1962) |
| ASHIFT | SHIFT EACH WORD OF AN ARRAY |
| ASORT | FTN ALPHANUMERIC SORT |
| ASORTMV | SORT 2-DIMENSIONAL ARRAY USING MOVLEV |
| BANR | PRINT A BANNER (PAGE) |
| BEJY0 | ZERO-ORDER BESSEL FUNCTIONS FOR REAL ARGUMENTS |
| BEJY1 | FIRST ORDER BESSEL FUNCTIONS FOR REAL ARGUMENTS |
| BESSI | MODIFIED BESSEL FUNCTION OF THE FIRST KIND |
| BESSJ | BESSEL FUNCTION OF THE FIRST KIND |
| BESSK | MODIFIED BESSEL FUNCTION OF THE SECOND KIND |

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|---|---|
| BESSY | BESSEL FUNCTION OF THE SECOND KIND |
| BMAN | SOLVE SYSTEM AX=B FOR BANDED SYMMETRIC MATRICES |
| BPOWR | EXPONENTIATION OF POWER SERIES IN TWO VARIABLES |
| BSJ | SPHERICAL BESSEL FUNCTION |
| CBSF | COMPLEX BESSEL FUNCTION FOR LARGE ARGUMENT |
| CEI3 | COMPLETE ELLIPTIC INTEGRAL OF THE THIRD KIND |
| CENTER | CENTER A CHARACTER STRING WITHIN AN OUTPUT FIELD |
| CGAUSS | COMPLEX SOLUTION OF SIMULTANEOUS EQUATIONS AND DETERMINANT BY ITERATIVE GAUSSIAN ELIMINTAION |
| CHFILL | FILL (PORTION OF) AN ARRAY WITH A CHARACTER |
| CMPINV | COMPLEX MATRIX INVERSION |
| COMBES | BESSEL FUNCTIONS FOR COMPLEX ARGUMENT AND ORDER |
| COMPSTR | COMPARE TWO CHARACTER STRINGS |
| CONTRCT | SQUEEZE ARRAY OF 1R-FORMAT CHARACTERS TO LEFT (SEE EXPAND) |
| COTAN | COTANGENT FUNCTION |
| COUPLE | LOGICALLY CONNECT TWO WORDS |
| CROTAB | READ TABLES FOR FRMRAN AND FRMRA2 INTERPOLATION |
| DISCOT | SINGLE OR DOUBLE INTERPOLATION |
| DMPA | CALLABLE OCTAL AND CHARACTER DUMP OF SPECIFIED PORTION OF USER'S FIELD LENGTH (FL) (BY ACTUAL LOCATION) (NO HEADINGS ARE PROVIDED) |
| DMPCPA | DUMP JOB CONTROL POINT AREA |
| DMPFIT | SHORT DUMP OF FTN OR RM FILE INFORMATION TABLE (FIT) |
| DPROOT | FIND ALL ROOTS OF A REAL DOUBLE PRECISION PLOYNOMIAL |
| DUMPA | GIVE OCTAL AND CHARACTER DUMP OF USER-SPECIFIED AREA |
| DUMPCPA | EXPANDED DUMP OF JOB CONTROL POINT AREA |
| DUMPFIT | DETAILED DUMP OF FTN OR RM FILE INFORMATION TABLE (FIT) |
| DUMPFL | CALLABLE OCTAL AND CHARACTER DUMP OF SPECIFIED PORTION OF USER'S FIELD LENGTH (FL) (BY ACTUAL LOCATION) |

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|---|---|
| ELLI | ELLIPTIC INTEGRAL |
| ELLIP | ELLIPTIC INTEGRAL |
| ELTIME | OBTAIN CPA, CPB, CP, PP, IO AND WALL CLOCK TIMES SINCE LAST CALL TO ELTIME |
| EQU60 | LOGICAL COMPARE (OF 2 ARRAYS) |
| ERF | ERROR FUNCTION |
| ERROR | ERROR FUNCTION |
| EXPAND | EXPAND CHARACTER STRING INTO ARRAY OF 1R-FORMAT WORDS (SEE CONTRCT) |
| EXPINT | EXPONENTIAL INTEGRAL |
| EXPRM | EXTRACT NEXT PARAMETER FROM EXECUTE CARD |
| EXTBIT | EXTRACT BITS FROM A WORD |
| EXTERM | EXTRACT NEXT PARAMETER FROM USER-SUPPLIED PARAMETER STRING |
| FASTIN | READ AND UNPACK DATA PREPARED ON THE XDS-910 A/D CONVERSION SYSTEM |
| FBINRD | UNPACK AN INPUT ARRAY (N BITS PER INPUT CHARACTER INTO COC WORD) |
| FFT | FAST FOURIER TRANSFORM FOR COMPLEX TABULATED FUNCTION |
| FFTS | FAST FOURIER TRANSFORM |
| FGI | FORTRAN GAUSSIAN INTEGRATION |
| FINDC | FIND PRESENCE OR ABSENCE OF SPECIFIED CHARACTER IN AN ARRAY (USER SPECIFIES RELATIONAL OPERAND) |
| FINDW | FIND PRESENCE OR ABSENCE OF SPECIFIED WORD IN AN ARRAY (USER SPECIFIES RELATIONAL OPERAND) |
| FINDWRD | FIND SPECIFIED WORD IN AN ARRAY |
| FNCL3 | INTEGRATE SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS |
| FRESNEL | EVALUATE FRESNEL INTEGRALS |
| FRMRAN | LINEAR TABLE INTERPOLATION (ONE OR TWO INDEPENDENT VARIABLES) |
| FRMRA2 | LINEAR TABLE INTERPOLATION (MULTIPLE INDEPENDENT VARIABLES) |
| FTNREL | GET/SET CORE SIZE |

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|---|---|
| GAMCAR | COMPLEX GAMMA FUNCTION OF A COMPLEX ARGUMENT HAVING POSITIVE REAL PART |
| GAMMA | INCOMPLETE OR COMPLETE GAMMA FUNCTION |
| GAUSS | SIMULTANEOUS EQUATION SOLUTION WITH DETERMINANT BY ITERATIVE GAUSSIAN ELIMINATION |
| GETCHA | EXTRACT CHARACTER FROM SPECIFIED POSITION IN AN ARRAY |
| GETCHR | EXTRACT CHARACTER FROM SPECIFIED POSITION IN A WORD |
| GETFIT | GET SPECIFIED FIT ADDRESS |
| GETLFNS | GET ACTUAL LOCAL FILE NAMES (FOR FTN) |
| GETPRM | GET ALL PARAMETERS ON EXECUTE CARD |
| GETRA | GET PROGRAM COMMUNICATION REGION (RA+0 THRU RA+77B) |
| GMHAS | HARMONIC ANALYSIS |
| GODROP | ISSUE USER-SPECIFIED GO/DROP MESSAGE |
| HELP | COMPLEX ZEROES OF REAL OR COMPLEX POLYNOMIAL |
| HERE | GET TERMINAL ID FOR THIS JOB |
| HIFAC | HIGHEST COMMON FACTOR OF TWO POLYNOMIALS |
| IAOC | COUNT ONE-BITS IN SPECIFIED WORD |
| IBUNP | UNPACK 12-BIT BYTES FROM ARRAY |
| ICOM | INTERACTIVE COMMUNICATOR (SYMBOLIC) -- READ RESPONSE AND COMPARE WITH LIST OF VALID RESPONSES |
| ICOMN | INTERACTIVE COMMUNICATOR (INTEGER NUMERIC) -- READ NUMBER AND TEST TO SEE IF IN SPECIFIED RANGE |
| IDAYWEK | FUNCTION TO DETERMINE THE DAY OF THE WEEK FOR ANY DATE FROM 10/15/1582 THRU 02/28/4000 |
| IDID | GET USER INITIALS (AND INTERCOM USER ID) FROM CHARGE CARD OR LOGIN |
| IDIGIT | CHECK FOR DIGITS IN A FIELD WITHIN A WORD |
| IFINDCH | FIND FIRST OCCURRENCE OF SPECIFIED CHARACTER IN ARRAY |
| IFMTV | FAST I-FORMAT DECODE OF VARIABLE LENGTH INPUT |

| | |
|---|---|
| IHMS | CONVERT SECONDS TO ' HH.MM.SS.' (SEE ISEC) |
| IPAKLFT | SQUEEZE LEFT AND REMOVE ZEROS (00B) AND BLANKS (55B), RETURN NUMBER OF CHARACTERS |
| IROMAN | CONVERT ROMAN NUMBERS TO INTEGER |
| ISEC | CONVERT HH.MM.SS TO SECONDS (SEE IHMS) |
| ISITCNF | TEST FOR CONNECTED FILE |
| ISTAPE | GENERATE TAPE NAME 'TAPENN' |
| ISUMIT | SUM ELEMENTS OF INTEGER ARRAY |
| JGDATE | CONVERT ANY GREGORIAN DATE TO A JULIAN DATE AND VICE VERSA (MULTI-YEAR) |
| JOBNAME | GET NOS/BE JOB NAME FOR THIS JOB |
| JOBORG | GET JOB ORIGIN (BATCH, INTERCOM, GRAPHICS, MULTI-USER) |
| JULIAN | CONVERT ANY GREGORIAN DATE TO A JULIAN DATE AND VICE VERSA (SINGLE YEAR) |
| KUTMER | INTEGRATE A SYSTEM OF FIRST-ORDER ORDINARY DIFFERENTIAL EQUATIONS USING THE KUTTA-MERSON FOURTH-ORDER, SINGLE-STEP METHOD |
| LASTC | FIND LAST NON-BLANK CHARACTER IN ARRAY |
| LASTWRD | FIND LAST WORD OF ARRAY WHICH CONTAINS A NON-BLANK CONTAINS A NON-BLANK |
| LBYT | EXTRACT VARIABLE LENGTH BYTE |
| LEFTADJ | SQUEEZE LEFT AND REMOVE BLANKS AND 00B (USER MAY SUPPLY TRAILING FILL CHARACTER) |
| LINE6 | SET PRINT FILE TO 6 LINES PER INCH |
| LINE8 | SET PRINT FILE TO 8 LINES PER INCH |
| LOGGAM | LOGARITHM OF GAMMA FUNCTION FOR COMPLEX ARGUMENT |
| LSQSUB | GENERAL WEIGHTED LEAST SQUARES FIT |
| MACHINE | GET 4-WORD SYSTEM HEADING |
| MAM | SOLVE SYMMETRIC SYSTEM OF LINEAR EQUATIONS |
| MAM200 | SOLVE 200 SYMMETRIC LINEAR EQUATIONS |
| MASKIT | DYNAMIC MASK GENERATOR |

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|---|---|
| MATINS | MATRIX INVERSE WITH SIMULTANEOUS EQUATION SOLUTION AND DETERMINANT |
| MAXE | FIND MAXIMUM VALUE OF AN ARRAY (ALSO CONTAINS AMAXE) |
| MFETCH | FETCH A SINGLE WORD FROM USER'S FL (SEE MSET) |
| MFX | OBTAIN THE MAINFRAME ON WHICH THE PROGRAM IS RUNNING |
| MINE | FIND MINIMUM VALUE OF AN ARRAY (ALSO CONTAINS AMINE) |
| MINMAX | GENERALIZED NONLINEAR ITERATOR |
| MONTH | FROM A DATE (MM/DD/YY) FIND THE MONTH AND RETURN FULL SPELLING AND 3- OR 4-CHARACTER ABBREVIATION |
| MOVSTR | MOVE A STRING OF CHARACTERS FROM ONE ARRAY TO ANOTHER |
| MSET | SET A SINGLE WORD IN USER'S FL (SEE MFETCH) |
| NEWDAT | ADD/SUBTRACT SPECIFIED NUMBER OF DAYS TO/FROM A GIVEN DATE |
| NFILL | FILL ELEMENTS 1 THRU N OF AN ARRAY WITH THE VALUES 1 THRU N, RESPECTIVELY |
| NFILLT | TEST AN ARRAY FOR THE PRESENCE OF THE INTEGERS 1 THRU N IN ELEMENTS 1 THRU N, RESPECTIVELY |
| NROOTS | REAL AND COMPLEX ROOTS OF REAL POLYNOMIAL |
| NUMEXEC | GET NUMBER OF EXECUTE CARD PARAMETERS WHICH WERE USED IN THIS EXECUTION OF THE PROGRAM |
| NUMVAR | DETERMINE NUMBER OF ARGUMENTS IN CALL TO SUBPROGRAM |
| OFMTDE | FAST O-FORMAT DECODE |
| OFMTV | FAST O-FORMAT DECODE OF VARIABLE LENGTH INPUT |
| OPLSA | ORTHOGONAL POLYNOMIAL LEAST SQUARE APPROXIMATION |
| OVLNAME | GET NAME OF FILE CURRENTLY BEING EXECUTED |
| PARGET | GET ALL PARAMETERS OF USER-SUPPLIED PARAMETER STRING |
| PERC | SUPPLY DESCRIPTION OF PERMANENT FILE FUNCTION RETURN CODE |
| PLOTMY | PRINTER PLOT - MULTIPLE CURVES |
| PLOTPR | PRINTER PLOT - MULTIPLE CURVES |
| PLOTXY | PRINTER PLOT - SINGLE CURVE |
| POLDIV | POLYNOMIAL DIVISION |
| POLYN | LEAST SQUARES POLYNOMIAL FIT |

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|---|---|
| POWR1 | 1 TERM IN EXPONENTIATION OF POWER SERIES - ONE VARIABLE |
| POWR2 | 1 TERM IN EXPONENTIATION OF POWER SERIES - TWO VARIABLES |
| PROD2 | 1 TERM IN PRODUCT OF POWER SERIES - TWO VARIABLES |
| PROOT | FIND ALL ROOTS OF A REAL PLOYNOMIAL |
| PRTFL | PRINT CURRENT FL (OR PUT INTO DAYFILE) |
| PRTIME | GET AND PRINT CPA, CPB, CP, PP, IO AND WALL CLOCK TIMES SINCE LAST CALL AND PRINT USER-SUPPLIED MESSAGE |
| PSI | COMPLEX PSI FUNCTION |
| PUTCHA | INSERT CHARACTER INTO SPECIFIED POSITION IN AN ARRAY |
| PUTCHP | INSERT CHARACTER INTO SPECIFIED POSITION IN A WORD |
| QSORT | IN-CORE ASCENDING SORT FOR ARRAYS LARGER THAN 500 WORDS |
| QSORT1 | IN-CORE ASCENDING SORT WITH RE-ORDERING OF ASSOCIATED ARRAY (FOR ARRAYS LARGER THAN 500 WORDS) |
| QUADG | INTEGRAL BY GAUSS-LEGENDRE 10-POINT QUADRATURE |
| QUART | REAL OR COMPLEX ROOTS OF QUARTIC |
| RANNUM | NORMALLY DISTRIBUTED RANDOM NUMBERS |
| RCPA | READ (A PORTION OF) CONTROL POINT AREA |
| RECOVRD | ON RECOVERY, PRINT EXCHANGE JUMP PACKAGE, RA+0 THRU RA+77B |
| REDUCE | REDUCE FL TO MINIMUM -OR- REQUEST ADDITIONAL FL RELATIVE TO START OF BLANK COMMON |
| REPLAC | REPLACE ONE CHARACTER WITH ANOTHER IN AN ARRAY |
| REPLACM | REPLACE SEVERAL CHARACTERS WITH OTHER CHARACTERS |
| REPLHI | REPLACE ALL CHARACTERS GREATER THAN SPECIFIED CHARACTER WITH NEW CHARACTER |
| REPLLO | REPLACE ALL CHARACTERS LESS THAN SPECIFIED CHARACTER WITH NEW CHARACTER |
| REPLNE | REPLACE ALL CHARACTERS (EXCEPT SPECIFIED CHARACTER) WITH A SPECIFIED CHARACTER |
| REQUEST | CALLABLE REQUEST COMMAND |
| RFFT | FAST FOURIER TRANSFORM FOR REAL TABULATED DATA |
| RFSN | REVERSE FAST FOURIER TRANSFORM |

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|---|---|
| ROOTER | GENERAL ROOT FINDER |
| ROUTE | CALLABLE ROUTE COMMAND |
| SBYT | STORE VARIABLE LENGTH BYTE |
| SEMICO | REPLACE DISPLAY CODE 00B WITH 77B (SEMI-COLON) |
| SENT | MOVE WORDS FROM ONE ARRAY TO ANOTHER, FORWARD OR BACKWARD |
| SETREW | CONVERT ALPHABETIC REWIND OPTION INTO RM OPEN AND CLOSE CODES |
| SHIFTA | SHIFT ARRAY A SPECIFIED NUMBER OF BITS (CROSSING OVER WORD BOUNDARIES) |
| SIMP | SIMPSON'S RULE INTEGRATION |
| SIMPUN | SIMPSON'S RULE INTEGRATION - UNEQUAL INTERVALS |
| SKPFIL | FORWARD OR BACKWARD SKIP FOR FORTRAN FILES |
| SKPSTAT | GET STATUS OF LAST CALL TO SKPFIL |
| SKWEZL | SQUEEZE LEFT AND REMOVE BLANKS AND 00B |
| SKWEZR | SQUEEZE RIGHT AND REMOVE BLANKS AND 00B |
| SMOOTH | LEAST SQUARES POLYNOMIAL SMOOTHING |
| SNCNON | JACOBIAN ELLIPTIC FUNCTION |
| SPLFIT | SPLINE CURVE FIT |
| SQFIT | POLYNOMIAL LEAST SQUARE FIT |
| SSORT | FTN SHELL SORT |
| SSORTF | FTN CALLABLE SHELL SORT FOR TWO-DIMENSIONAL ARRAYS |
| SSORTI | FTN CALLABLE SHELL SORT FOR TWO-DIMENSIONAL ARRAYS |
| SSORTL | FTN LOGICAL SHELL SORT |
| STUTEE | STUDENT'S T DISTRIBUTION |
| SUMIT | SUM ELEMENTS OF REAL ARRAY |
| TRAILBZ | CHANGE TRAILING BLANKS TO ZEROS (00B) |
| UNLOAD | UNLOAD A FORTRAN FILE |
| VALDAT | LOGICAL FUNCTION TO VALIDATE A DATE FORMAT |
| VALIDT | VALIDATE AN ARRAY TO SEE THAT EACH ELEMENT IS ONE OF A USER-SPECIFIED LIST |

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|---|---|
| VAPAH1 | EIGENVALUES AND EIGENVECTORS OF A GENERAL REAL MATRIX |
| VAPAH2 | IMPROVED ESTIMATES AND BOUNDS FOR EIGENSYSTEM OF A GENERAL REAL MATRIX |
| VFILL | FILL AN ARRAY WITH USER-SPECIFIED WORD |
| WEKDAY | DETERMINE THE DAY OF THE WEEK FOR ANY GREGORIAN DATE FROM OCTOBER 15, 1582 THRU FEBRUARY 28, 4000 |
| XFIL | FILON'S METHOD FOR INTEGRALS WITH SIN AND COS |
| XOR | EXCLUSIVE-OR FUNCTION |
| ZBLANK | CHANGE BLANKS TO 00B AND VICE VERSA |
| ZEROES | REPLACE BLANKS WITH (DISPLAY CODE) ZEROS, MULTIPLE FIELDS |
| ZEROFL | ZERO FIELD LENGTH (SECURITY EOJ) |
| ZEROS | REPLACE BLANKS WITH (DISPLAY CODE) ZEROS, MULTIPLE FIELDS |
| ZPFPUT | PUT USER-SPECIFIED PARAMETERS INTO ARRAY FOR LATER CALL TO ZPFUNC |
| ZPFUNC | CALLABLE PERMANENT FILE FUNCTIONS |
| ZRTPUT | PUT USER-SPECIFIED PARAMETERS INTO ARRAY FOR LATER CALL TO ROUTE |
| ZSYSEQ | FORTRAN CALLABLE SYSTEM CALL |

## ***** CATALOGUED PROCEDURES *****

A CATALOGUED PROCEDURE IS A SET OF CONTROL CARDS WHICH ACCOMPLISH A TASK. THE COMPUTER CENTER MAINTAINS A LIBRARY OF THESE FOR GENERAL USE. THIS CHAPTER INCLUDES THE DESCRIPTIVE TITLE FOR EACH PROCEDURE IN THE LIBRARY. MOST OF THE PROCEDURES ARE EXECUTED BY:

BEGIN,<PROCNAME>,,<PARAMETERS>.

REFERENCES: CCLIB/P, WHICH MAY BE OBTAINED FROM USER SERVICES.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROGRAM 'PROGDOC' (SEE PAGE 1-2).

THE FOLLOWING PROCEDURES ARE AVAILABLE:

| | |
|---|---|
| ANYLIB | EXECUTE A PROGRAM ON ANY EDITLIB USER LIBRARY (HAVING A PFN OF 1-7 CHARACTERS) |
| ANYPRO | EXECUTE A PROCEDURE ON ANY CATALOGUED PROCEDURE FILE (HAVING A PFN OF 1-7 CHARACTERS) |
| AUDIT | SORTED USER AUDIT |
| CALC3D | THREE-D PROCEDURE FOR CALCOMP 763, 936, 1700 PLOTTERS |
| CCIRM | PRINT ONE COPY OF COMPUTER CENTER INTRODUCTORY REFERENCE MANUAL |
| CCLIB | PRINT ONE COPY OF CCLIB, CCLIB/M, CCLIB/N, CCLIB/P, OR CCLIB/U MANUAL |
| CCRM | PRINT COPIES OF THE COMPUTER CENTER REFERENCE MANUAL |
| COPYBLK | REBLOCK STRANGER TAPES TO SCOPE STANDARD FILES (BOTH UNBLOCKED CARD AND PRINT LINE IMAGE TAPES AND BLOCKED STRANGER TAPES) |
| COPYLIB | CONDENSE (AND SORT) AN EDITLIB USER LIBRARY PRESERVING AL, FL, FLO VALUES. BINDEX AND LISTBIN LISTS ARE PROVIDED. |
| COPYS | ATTACH, EXECUTE AND RETURN THE RIQSCOPYS PROGRAM |
| CPINDEX | CONVERT SEQUENTIAL PROCEDURE FILE TO RANDOM |
| CV29 | CONVERT TO 029 PUNCH CODE |
| DOCADD | ADD ONE DOCUMENT TO A DOCUMENTATION FILE |
| DOCDELE | DELETE ONE DOCUMENT FROM A DOCUMENTATION FILE |
| DOCDOC | LIST DOCUMENTATION FOR PROCEDURES DOCADD, DOCDELE, DOCDOC, DOCFILE, DOCGET, DOCLIST, DOCREPL |
| DOCFILE | ATTACH A DOCUMENTATION FILE |
| DOCGET | GET (EXTRACT) SPECIFIED DOCUMENT FROM A DOCUMENTATION FILE |

| | |
|---|---|
| DOCLIST | LIST DOCUMENT NAMES (ON *DECK) CARDS IN A DOCUMENTATION FILE |
| DOCREPL | REPLACE ONE DOCUMENT IN A DOCUMENTATION FILE |
| DOCTAPE | EXTRACT DOCUMENTS FROM TAPE |
| GRIPE | ALLOW USER TO MAKE GRIPES OR SUGGESTIONS DIRECTLY TO THE COMPUTER |
| LIBSET1/2 | CREATE SIMPLE ABSOLUTE USING ONE/TWO EDITLIB LIBRARY(IES) |
| LINE8/6 | SET PRINT FILE TO 8/6 LINES PER INCH |
| MEX | TELL USER THE MAINFRAME ON WHICH HE IS RUNNING |
| MNSRDC | EXECUTE A PROGRAM ON EDITLIB USER LIBRARY 'MNSRDC' |
| MYPRC | EXECUTE A PROCEDURE ON FILE 'PROFIL' CATALOGED UNDER ANY ID |
| NOGO | CREATE SIMPLE ABSOLUTE FROM RELOCATABLE |
| NOREPUN | INSURE THAT A BATCH JOB CANNOT BE RERUN BY OPERATOR TYPE-IN |
| PGMTAPE | EXTRACT SOURCE PROGRAMS FROM TAPE |
| PM | CREATE CERTAIN PRINT MESSAGE (PM) RECORDS |
| PROADD | ADD ONE PROCEDURE TO A SEQUENTIAL PROCEDURE FILE |
| PROALL | LIST PROCEDURE NAMES, PROCEDURE HEADERS AND THE PROCEDURES IN A SEQUENTIAL PROCEDURE FILE (COMBINES PRONAM, PROHDR AND PROLIST) |
| PRODELE | DELETE ONE PROCEDURE FROM A SEQUENTIAL PROCEDURE FILE |
| PRODOC | LIST DOCUMENTATION FOR PROCEDURES PROADD, PROALL, PRODELE, PRODOC, PROGET, PROHDR, PROLIST, PRONAM, PROREPL |
| PROGET | GET (EXTRACT) ONE PROCEDURE FROM A SEQUENTIAL PROCEDURE FILE |
| PROGRAM | EXECUTE A CATALOGED PROGRAM (NOT IN A LIBRARY) |
| PROHDR | LIST PROCEDURE HEADERS IN A PROCEDURE FILE |
| PROLIST | LIST PROCEDURE(S) IN A SEQUENTIAL PROCEDURE FILE |
| PRONAM | LIST NAMES OF PROCEDURES IN A SEQUENTIAL PROCEDURE FILE |
| PROREPL | REPLACE ONE PROCEDURE IN A SEQUENTIAL PROCEDURE FILE |

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|---|---|
| RECADD | ADD ONE OR MORE LOGICAL RECORDS TO A FILE |
| RECDELE | DELETE ONE OR MORE LOGICAL RECORDS FROM A FILE |
| RECDOC | LIST DOCUMENTATION FOR PROCEDURES RECADD, RECDELE, RECDOC, RECGET, RECREPL |
| RECGET | EXTRACT ONE OR MORE LOGICAL RECORDS FROM A FILE |
| RECREPL | REPLACE ONE OR MORE LOGICAL RECORDS IN A FILE |
| RENAMAC | RENAME AC FIELD ON PERMANENT FILES |
| RUNBAS | COMPILE AND EXECUTE BASIC PROGRAM (SIMILAR TO EDITOR RUN,BAS FOR USE OUTSIDE EDITOR) |
| RUNFTN | COMPILE AND EXECUTE FTN PROGRAM (SIMILAR TO EDITOR RUN,FTN FOR USE OUTSIDE EDITOR) |
| RUNMNF | COMPILE AND EXECUTE MNF PROGRAM |
| RUNSEQ | COMPILE AND EXECUTE FTN,SEQ PROGRAM (SOURCE PROGRAM IN SEQUENCED FORMAT - TIME-SHARING OPTION) |
| RUNTS | COMPILE AND EXECUTE FTN,TS PROGRAM (TIME-SHARING OPTION) |
| SELDUMP | CREATE BACKUP DUMP TAPE OF USER PERMANENT FILES OF AN ACCOUNT NUMBER |
| SELLOAD | RESTORE SELECTED ROUTINES FROM A BACKUP DUMPF TAPE |
| SEND | SEND MESSAGES TO AN INTERCOM USER WHO IS NOT LOGGED IN; LIST MESSAGES |
| STRUCT | GENERATE CROSS-REFERENCE LISTS AND TREE STRUCTURE FROM BINARY RELOCATABLE OBJECT FILE |
| S2K260 | ATTACH FILES FOR S2000 (VERSION 2.60) NATURAL LANGUAGE, FTN, OR COBOL PROCEDURAL LANGUAGE INTERFACE FROM PROPER DEVICE |
| S2000 | ATTACH OR RETURN FILES FOR S2000 NATURAL LANGUAGE, FTN OR COBOL PROCEDURAL LANGUAGE INTERFACE FROM PROPER DEVICE |
| TIDBITS | LIST FILE OF TIDBITS (HINTS ON IMPROVED COMPUTER USAGE) |
| TRANPAK | COPY CONTENTS FROM ONE DEVICE SET TO ANOTHER FOR BACKUP |

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|---|---|
| UPDADD | ADD ONE DECK TO AN UPDATE LIBRARY |
| UPDDELE | DELETE ONE DECK FROM AN UPDATE LIBRARY |
| UPDDOC | LIST DOCUMENTATION FOR PROCEDURES UPDADD, UPDDELE, UPDDOC, UPDGET, UPDLIST, UPDREPL |
| UPDGET | EXTRACT ONE DECK FROM AN UPDATE LIBRARY (UPDATE,C) AND, OPTIONALLY, ADD EDITOR SEQUENCING |
| UPDGETS | EXTRACT ONE DECK FROM AN UPDATE LIBRARY (UPDATE,S) AND, OPTIONALLY, ADD EDITOR SEQUENCING |
| UPDGETT | EXTRACT ONE DECK FROM AN UPDATE LIBRARY (UPDATE,T) AND, OPTIONALLY, ADD EDITOR SEQUENCING |
| UPDLIST | LIST DECK/COMDECK NAMES IN UPDATE LIBRARY WITH COUNT OF RECORDS IN EACH DECK/COMDECK |
| UPDREPL | REPLACE ONE DECK IN AN UPDATE LIBRARY |
| UTILITY | EXECUTE A PROGRAM ON LIBRARY 'UTILITY' |
| VENUS | ATTACH AND EXECUTE ONE OF THE VENUS RETRIEVAL PROGRAMS |
| WHATLIB | LIST LIBRARIES SPECIFIED IN LAST 'LIBRARY' COMMAND |

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